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VOLUME 3

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THE TREATMENT OF HEMANGIOMAS OF THE HEAD AND NECK*

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Hemangiomas may involve any organ or tissue of the body but the great majority of them occur about the head and neck. The proportion found in this situation has been estimated to be as high as 95 per cent of the total (Bellot (1)). Most of these tumors involve only the skin and the tissues immediately underlying it but a few are localized entirely within the mouth, nose, pharynx and larynx. Many of them are small and entirely asymptomatic; some attain huge proportions and produce marked deformity and dysfunction. Ulceration may occur spontaneously or as a result of trauma, and recurring acute infection is not unusual. Serious or even fatal hemorrhage is a possibility. These considerations, together with the fact that two thirds of these vascular tumors occur in females, in whom appearance is of paramount importance, render them of especial interest to the plastic surgeon.

Much confusion regarding the nomenclature of the various forms of hemangiomas exists in the literature and many authors have presented their own classification. In general there are two principal types, the capillary and the cavernous.

The capillary hemangiomas include the port-wine stain or nevus flammeus and the strawberry birthmark or hemangioma simplex. The latter are circumscribed, finely lobulated, slightly elevated lesions composed of a new growth of dilated capillaries, veins and arterioles. They are bright red to purple and may occur on any part of the surface of the body but are most common on the face, trunk and arms. The lips, especially the upper lip, frequently are involved.

Capillary hemangiomas of the port-wine stain type are usually flat, nonelevated lesions varying from faint pink to bright red or magenta. Microscopically these present in the skin a narrow zone of dilated vessels lined with adult endothelium. They often are present on the lips and extend over a considerable portion of the oral mucous membrane. Not infrequently the involved regions are enlarged to a varying extent, owing to the presence of an associated cavernous hemangioma.

Cavernous hemangiomas are soft compressible tumors consisting of large thin-walled sinuses with a limited quantity of intervening stroma. Tumors of this type are not uncommon about the face and usually they are asymptomatic. They may, however, produce marked enlargement of the nose, ears, lips and other facial structures as well as of the tongue, and seriously interfere with function. Severe hemorrhage due to slight trauma is an ever-present possibility. Fatal hemorrhage resulting from dental extraction in cases of cavernous hemangioma

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of the mouth has been reported by Broderick and Round (2) and by Kroh (3). Tumors of this type in the frontal and temporal regions may produce severe persistent pain. This complaint is more likely to be made when phleboliths are present in the tumor than when they are absent.

A case of marked macroglossia due to a hemangioma of the tongue observed a few years ago was of particular interest. The patient was a man fifty years of age. The tongue was so greatly enlarged and elongated that it readily protruded below the point of the chin and rendered it difficult for the patient to close his mouth. During the periods of acute inflammatory reaction in the tongue, which recurred at frequent intervals, complete closure of the mouth was impossible. Not only were the functions of speech and deglutition interfered with but the patient's rest was disturbed seriously. This disturbance of rest resulted from the fact that whenever he dropped off to sleep the tongue became excessively engorged and protruded from the mouth much like a phallic erection

FIG. 1. PHLEBOLITHS REMOVED FROM CAVERNOUS HEMANGIOMA OF THE CHEEK

Plexiform or racemose hemangiomas, also known as cirsoid aneurysms, are closely allied to the cavernous hemangiomas but are encountered much less frequently. Actually they probably are essentially cavernous hemangiomas with single or multiple arteriovenous fistulas. They are expansile pulsating tumors which may be diffuse and of considerable extent. They can be only partially obliterated by compression and they become more tense than simple cavernous angiomas when the patient strains or the involved part is dependent. A bruit usually is audible on auscultation over the surface and a distinct thrill frequently is palpable. Because of the arterial pressure they are firmer than the simple cavernous hemangiomas and they tend to progress. The term "malignant" has been applied to this type of hemangioma but its implication does not seem entirely justified.

PHLEBOLITHS

Phleboliths are commonly encountered in cavernous hemangiomas in adults. They vary from rather soft, friable, almost putty-like consistency to calcareous hardness and range in diameter from 2 or 3 mm. to more than 1 cm. (fig. 1).

In a given case they are likely to be of approximately the same size but wide variation in diameter may exist. Usually they are few; generally from two to six are palpable but a score or more may be present. They often produce no symptoms and universally are considered of little clinical significance. However, frequently they cause a good deal of discomfort, especially when present in a hemangioma overlying a bony surface which is subjected to pressure. Patients who have hemangiomas of the cheek often complain of pain when they lie with the side of the face on a pillow, owing to pressure of a phlebolith against the jaws or the malar prominence. In these situations phleboliths tend to traumatize the soft tissue sufficiently to produce persistent tenderness with some induration and more or less continuous discomfort.

TREATMENT

Capillary hemangiomas.—Since the blood vessels composing the strawberry type of capillary hemangioma are lined with an embryonic form of endothelium, these growths in infants respond well to radiation and usually are best dealt with by means of a screened radium plaque. Cautious application of radium with the plaque kept moving continuously will result as a rule in complete disappearance of tho hemangioma and leave little visible scarring. Some physicians prefer to treat these vascular growths by excision or by applications of carbon dioxide snow, but in the hands of my colleagues and myself, radiation has yielded most satisfactory results and produced a minimum of scarring. I have not used applications of collodion in these cases as described by Krüger (4) nor have I had sufficient faith in the likelihood of such lesions disappearing spontaneously to feel justified in withholding treatment during infancy. None of the port-wine stains that we have left untreated have faded out of themselves.

As previously noted, port-wine stains are formed largely of blood vessels lined with a flattened adult type of endothelium. Accordingly one would naturally expect little or no response to radiation and this is definitely the case. Yet in spite of this usual observation and its frequent publication in the literature these lesions continue to be subjected to repeated applications of radium and roentgen therapy. As a result actinodermatitis with subsequent malignant degeneration is often observed in these cases. Less serious sequelae are unsightly depressed scars and mottling which also may result from applications of carbon dioxide snow. MacCollum (5) reported 80 per cent of cures of such lesions in children with the administration of a blistering dose of air-cooled ultraviolet radiation at weekly intervals for from four to nine months. I have not used this method of treatment nor observed the results of it (fig. 2*a* and *b*).

In my experience port-wine capillary hemangiomas of the lips without associated cavernous involvement in women usually are best taken care of by means of cosmetics which serve to conceal them effectively when skillfully applied. Such applications are distasteful to men and if the patient is not disturbed mentally by the condition, no treatment is indicated. When the situation warrants because of undue self-consciousness, unsightly scarring from previous treatment

FIG. 2*a*. Actinodermatitis with epithelioma resulting from irradiation of nevus flammeus; *b*, result following removal and repair by means of pedicle flap from the anterolateral aspect of the left arm. (Reproduced, with permission of the publishers, from: Figi, F. A., New, G. B. and Dix, C. R.: Radiodermatitis of the head and neck, with a discussion of its surgical treatment. Surg., Gynec. & Obst. 77: 284-294 [Sept.] 1943).

FIG. 3*a*. UNTREATED NEVUS FLAMMEUS; *b*, RESULT FOLLOWING EXCISION AND REPAIR WITH A FREE SPLIT GRAFT IN A SINGLE STAGE

or actinodermatitis, excision with application of a skin graft is the treatment of choice (fig 3a and b) Inside the mouth these lesions obviously are of no consequence and treatment is not necessary When a nevus flammeus of the lip is associated with a cavernous hemangioma which is producing deforming enlargement, the latter lesion should be controlled by electrocoagulation or by injection of a sclerosing solution before excision and plastic repair of the involved surface are undertaken

Cavernous hemangiomas —Cavernous hemangiomas of the head and neck in infants and children are best treated with radiation Radon seeds of from 0 25 to 0 3 mc each, implanted into the tumor and spaced approximately 1 cm apart, usually produce satisfactory reduction with a minimum of deleterious

a b

FIG 4a EXTENSIVE CAVERNOUS AND CAPILLARY HEMANGIOMA OF THE FACE AND NECK, b, RESULT FOLLOWING INTERSTITIAL AND SURFACE RADIATION

effects Such treatment can be repeated in from four to six months if indicated (fig 4a and b) While roentgen therapy or radium packs will sclerose these cavernous lesions if applied repeatedly, their use is indicated in only the diffuse lesions of this type and in these they are applied to supplement interstitial radiation Repeated external therapy is likely to produce pigmentation, telangiectasia and sclerosis in the overlying skin and interfere with subsequent development of the soft tissues and bony structures Such unfortunate results are now being observed in some of the patients treated years ago by this method

Cavernous hemangiomas presenting on the cutaneous surface may be treated with injections of boiling water according to the method of Wyeth (6) However, some of the other sclerosing agents, notably 5 per cent solution of sodium

morrhuate, appear to be equally effective, are more easily handled and involve less risk of slough. During the injection of a sclerosing solution peripheral pressure should be maintained in order to prevent too rapid diffusion of the agent and to lessen the possibility of embolism. Maintaining the pressure for some hours following the injection has appeared also to increase the efficacy of this type of

Fig. 5a. Cavernous Hemangioma of the Cheek with Deformity Resulting from Previous Electrocoagulation; b, Result Following Several Injections of Sclerosing Solution, Relining of Buccal Fold with Skin Graft and use of Prosthesis

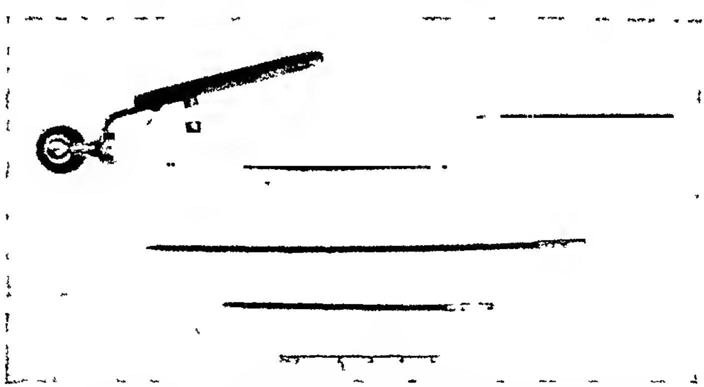

Fig. 6. Insulated Electrode used in Electrocoagulation of Cavernous Hemangiomas

treatment (fig. 5a and b). About the head and neck injection of a sclerosing solution frequently is ineffective because of the impossibility of localizing the solution for a sufficient period. The injection of boiling water and other sclerosing agents into the tongue and other intra-oral and pharyngeal hemangiomas involves the possibility of sepsis and of producing excessive local reaction with

edema, which may spread to the larynx and induce respiratory obstruction. I feared that tracheotomy would be necessary after injection of boiling water in

Fig. 7. A. Hemangiomas of the mouth Ann Otol, Rhin & Laryng (In press.)

FIG 8 LARGE CAVERNOUS HEMANGIOMA OF THE TONGUE BEING ELECTROCOAGULATED WITH INSULATED ELECTRODE INSERTED INTO THE TUMOR THROUGH THE SUBMENTAL REGION

one of my cases in which the tongue was involved and it was required within a few hours after such an injection in one of Reder's (7) cases.

Because of its better localization and greater effectiveness cavernous hemangiomas of the face, scalp and intra-oral structures in adults are more satisfactorily treated by means of electrocoagulation than with sclerosing agents. For this purpose a sharp pointed, insulated electrode is employed (fig. 6). This is inserted into a hemangioma presenting on the cutaneous surface either directly or through a small stab wound in the adjacent normal skin. Intra-oral lesions are treated by inserting the electrode through the overlying mucous membrane or by introducing it through a stab wound in the skin. With the latter approach it is essential that the insulation of the shaft of the electrode be intact; otherwise leakage of the current may damage important structures and at the same time prevent sufficient coagulation of the neoplasm. More intensive coagulation of the vascular tumor is necessary than might be anticipated by the uninitiated since the heat is diffused rapidly by the blood, and carbon forming on the electrode tends

FIG. 9*a*. LARGE CAVERNOUS HEMANGIOMA OF THE TONGUE; *b*, RESULT ABOUT THREE WEEKS AFTER ELECTROCOAGULATION (REPRODUCED, WITH PERMISSION OF THE PUBLISHERS, FROM: FIGI, F. A.: HEMANGIOMAS OF THE MOUTH. ANN. OTOL., RHIN. & LARYNG. [IN PRESS.])

to produce effective insulation. The intensity of the coagulation should be checked by keeping a finger directly over the tip of the electrode and also by observing the surface of the tumor during electrocoagulation. If the color of the mucous membrane changes even slightly from red to gray, coagulation should be stopped immediately. The margin of safety between effective electrocoagulation and that which will result in a slough is very narrow and can be determined only by experience.

As might be anticipated, coagulation proceeds more rapidly when the blood is kept expressed from the tissues immediately about the electrode. Unless sloughing occurs, secondary hemorrhage is unusual in these cases. Primary bleeding from the stab wound in the skin or mucous membrane is readily controlled by superficial coagulation as the electrode is withdrawn.

During the coagulation the electrode should be kept as far as possible from Stensen's duct, the muscles of mastication, the motor nerves and other impor-

tant structures (fig. 7*a*, *b* and *c*). It is especially important that ample clearance be given the branches of the facial nerve. Spasm of the facial muscles often will occur during intensive electrocoagulation even when the tip of the electrode is 1 cm. or more from a branch of the facial nerve. This may result from direct stimulation of the muscle or from transmission of the current to the nerve by the intervening tissues. Accordingly, active contraction of the facial muscles is not necessarily an indication of impending injury to the seventh nerve.

Often I insert an insulated electrode through a small stab wound in the submental region or the anterior part of the submaxillary region for treating large cavernous hemangiomas of the tongue and floor of the mouth (fig. 8). This procedure obviates direct contamination of the coagulated region and if care is taken to avoid burning through the oral mucosa the operative wound remains clean, there is little likelihood of secondary bleeding and convalescence is materially shortened. This method has proved most effective in shrinking down some of these lesions that had not responded to radiation or to injection of sclerosing agents (fig. 9*a* and *b*).

Plexiform hemangiomas—Plexiform or racemose hemangiomas are more difficult to obliterate than simple cavernous angiomas because of the increased pressure within the component blood vessels resulting from the arteriovenous communications. The force of the impulse presented by these tumors is directly dependent on the size of the fistulous openings and is a factor in determining the type of treatment indicated. These lesions are encountered most often in adults but they may occur in infants. When seen early in life interstitial radiation may control them but ligation of the afferent vessels frequently is also necessary. In adults lesions of this type with only a slight impulse often can be shrunk by means of electrocoagulation, while radiation or injection of sclerosing agents alone is not likely to be of benefit. If the lesion is not too extensive, excision may be feasible and at times is the most effective means of control. This frequently is the case also when the expansile force is pronounced. On surgical exploration in many of these cases the arteriovenous communications often can be found. After ligation of these, electrocoagulation and chemical sclerotics may completely obliterate the lesion. Because of the free collateral circulation, ligation of the external carotid artery usually is less effective than tying off the afferent vessels directly about the periphery of the tumor. In an occasional case the mass will become flaccid immediately after ligation of a single large vessel at its border and electrocoagulation or the injection of boiling water or of a chemical sclerosing agent then will readily bring it under control.

Even though an extensive vascular tumor of the face is completely eradicated, considerable enlargement of the involved region may persist and leave the patient's appearance less satisfactory than was anticipated. This commonly results from diffuse overdevelopment of the bony structures due to the increased vascularity during the period of growth. This residual facial deformity may be sufficiently marked to render removal of the osseous enlargement advisable. For this, approach may be made through a submaxillary or a preauricular incision. On the other hand absorption of bone may result from the constant pressure of

an encapsulated hemangioma and a depression in the bone may remain at the site of eradication of such a tumor.

Phleboliths.—In cases in which phleboliths in hemangiomas about the face cause discomfort, removal of the offending calculi is indicated. Usually these vein stones are readily palpable and they may be removed with very little bleeding. Removal is accomplished by holding the stone firmly against the bone or against a finger placed inside the mouth with the soft tissues drawn tightly over it. The skin is then incised and the soft tissues are spread with sharp pointed scissors until the phlebolith is exposed. In this manner the offending concretion can be expressed through a surprisingly small opening.

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EXPERIMENTAL AND CLINICAL STUDIES OF REDUCED TEMPERATURES IN INJURY AND REPAIR IN MAN*

II Effect of Moderate Cold and Refrigeration on Wound Healing and Regeneration of Human Skin†

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In the preceding paper (1) we have pointed out that the study of the behaviour of wound healing and tissue regeneration under the influence of reduced temperature forms an important phase of the broad investigative project encompassing the experimental and clinical study of the effects of reduced temperatures on injury and repair of human tissues Apart from the broader aspect of the pathogenesis of injury by cold, considerable interest has been stirred up in the recent literature on the effect of local reduced temperatures in a variety of conditions including the treatment of burns (3, 4, 5, 6, 7) Baxter and More (2) reviewed the work done in that field in a paper which reported the results of their own work with experimental animals, they cited the work of several authors who recommend the clinical application of hypothermia for burns in man Before adequate appraisal of the effect of cold on healing of burns in man could be undertaken, it was well to know what effect cooling has on the healing of clean surgical wounds particularly with regards to the rate of epithelization and fibrous tissue formation

"Dermatome donor sites"—areas from which a uniform layer of skin was removed with the Padgett-Hood dermatome, were selected for the purpose of the experimental study Fresh dermatome donor areas have several features which make them suitable for the study of the effect of cold on wound healing

(a) Uniform thickness of split skin can be removed from two or more comparable sites thus providing standard areas where spontaneous healing with fibrous tissue formation and epithelization can occur

(b) It is possible to vary the time required for spontaneous healing by removing thinner or thicker layers of skin

(c) The behaviour and rate of epithelization has been extensively studied and a standard type of dressing giving optimal spontaneous healing is now used routinely in skin grafting providing a condition where alteration of the temperature of the environment is the only variable factor

(d) In spite of the obvious difference of the two conditions, dermatome donor areas are somewhat similar to moderate burns of skin in that in both cases skin

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is destroyed to a certain depth and re-epithelization of the area, apart from the proliferation from the edges of the wound, takes place from the portion of hair follicles, sweat glands and ducts that remain intact.

METHODS OF INVESTIGATION

Donor areas on the antero-lateral aspects of the thighs in the healthy adult were selected for this experimental study. The cooling was obtained by placing the entire limb into a special apparatus constructed for that purpose (fig. 1). The apparatus has two chambers, in one of which cold air circulates in a closed

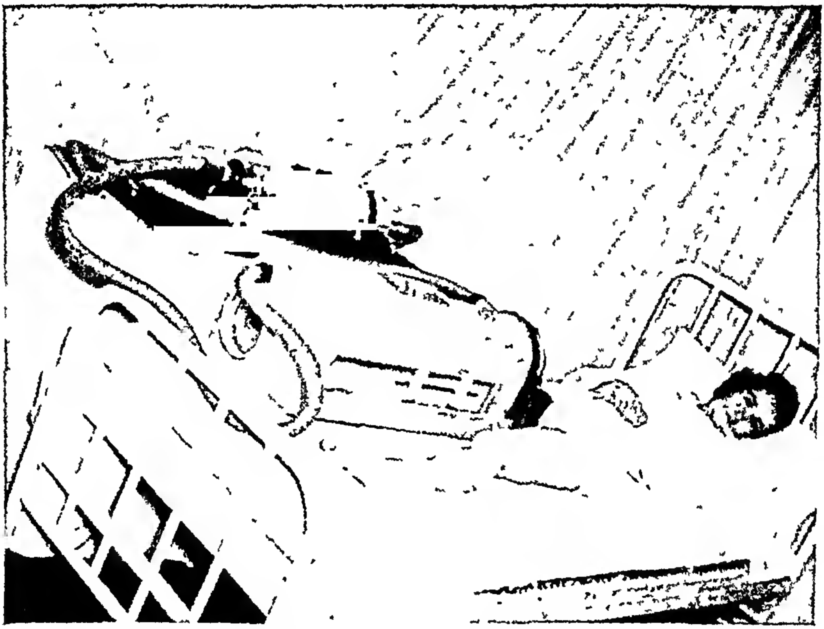

FIG. 1 THE COOLING APPARATUS
The "cold" chamber containing the patient's right leg is shown without the insulating cover. The cold air circulates in the closed circuit between the cooling unit beside bed and the cold chamber. The "warm" chamber is not shown in the photograph; through it air at room temperature is kept in motion by a fan. A thermostat permits regulation of the temperature in the "cold" chamber.

circuit, in the other—air at room temperature is similarly kept in motion for the control limb. The alterations of the state of vascular system of the areas under observation were determined by recording of the skin temperatures with constantan-copper thermocouples sutured to the selected sites.

The usual aseptic technique was followed in the removal of uniform layers of skin from the selected areas. Usually skin grafts 0 016 in. in thickness were removed with the dermatome (fig. 2). The thermocouples were sutured under the Bettman's gauze which was used routinely on all donor sites. The majority of cases had no other dressing applied to the wound. When the patients had re-

covered from the anaesthetic the limbs were placed in their respective chambers which were lined with sterile towels The temperature of the chambers was maintained fairly constant by providing a snugly fitting sleeve which encircled the upper portion of the thigh

Apart from the difference in the temperature of environment the treatment of the donor sites was identical In one case, however, pressure dressing was placed on the control area over the Bettman's gauze while the experimental area was covered with Bettman's gauze alone The duration of the cooling varied. some cases were removed from the apparatus entirely at the time of healing of the control, one patient's leg was kept in the cold chamber until it healed In another case the patient's limb was cooled for 5 days and then restored to room temperature with application of pressure dressing

The recording of temperatures (oral, warm and cold chambers, cooled leg and control) was usually done three times per day and occasionally continuously during the critical phases, such as the removal of the limb from the cold chamber Particular attention was given to the appearance of the donor sites, the amount of exudate, the discomfort and pain in the wound areas, and the manner and rate of healing Biopsies were taken usually at the time of healing of the control area, at the time of healing of the cold treated area and, subsequently, at weekly intervals Two of the patients had biopsies at monthly intervals up to 6 months after cooling Other relevant procedures will be mentioned in the protocols of the cases presented below

EXPERIMENTS AND OBSERVATIONS

Donor sites were used in this series of experiments designed to study the effect of cold on wound healing, a process which involves, in the skin, fibrous tissue formation to replace the dermis, and epithelial regeneration to restore the continuity of the epidermis Under optimum conditions, the healing of a dermatome donor site from which 0 016 in of skin have been removed (fig 2) occurs spontaneously in 8 to 10 days The process of normal healing is shown by a sequence of biopsies taken from a typical case (figs 6, 8, 10 and 12) Bettman's gause is applied directly to the denuded area of the donor site If no additional dressing is used, as was the case in most of our experiments, the exudate permeates through the gauze and forms a superficial sero sanguinous crust which does not interfere with the process of repair At about 6 days post-operatively the exudate practically ceases, at about the eighth day it is possible to raise the gauze from the donor site usually without undue discomfort to the patient This is the point at which epithelization is assumed clinically to be complete The donor site is covered with a shiny layer of pinkish epithelium which is velvety to touch (figs 14, 15 and 16, left thighs) However, the examination of the biopsies provides the verification of the end point of healing

Microscopically, a mild acute inflammatory process takes place during the first 72 hours sero sanguinous exudate is seen at the surface, polymorphonuclear leucocytes invade the area around the vascular and lymphatic channels, and later spread over the surface of the denuded area, subsequently a fibrinous layer

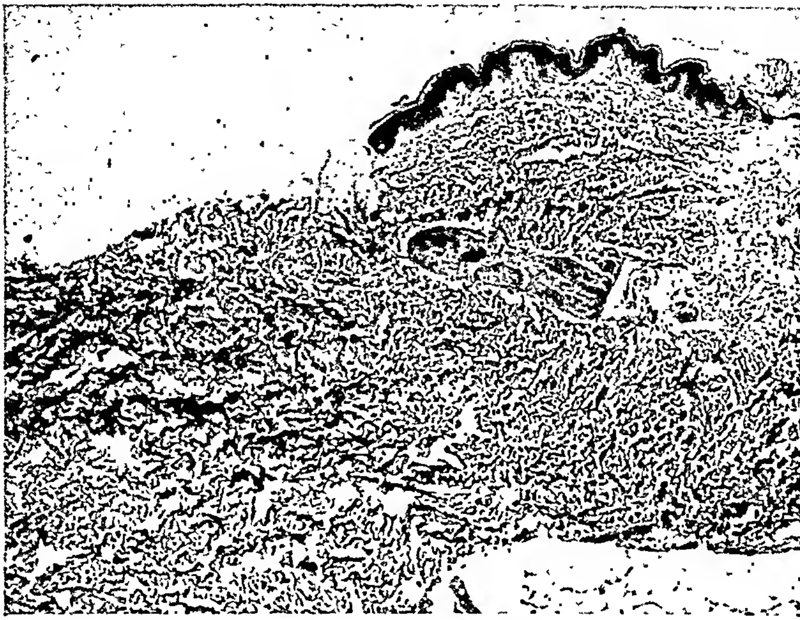

FIG. 2. DERMATOME DONOR AREA FROM WHICH 0.016 IN. OF SKIN HAS BEEN REMOVED

Junction with normal skin is seen in the center of the section. Haematoxylin-eosin. Magnification × 40.

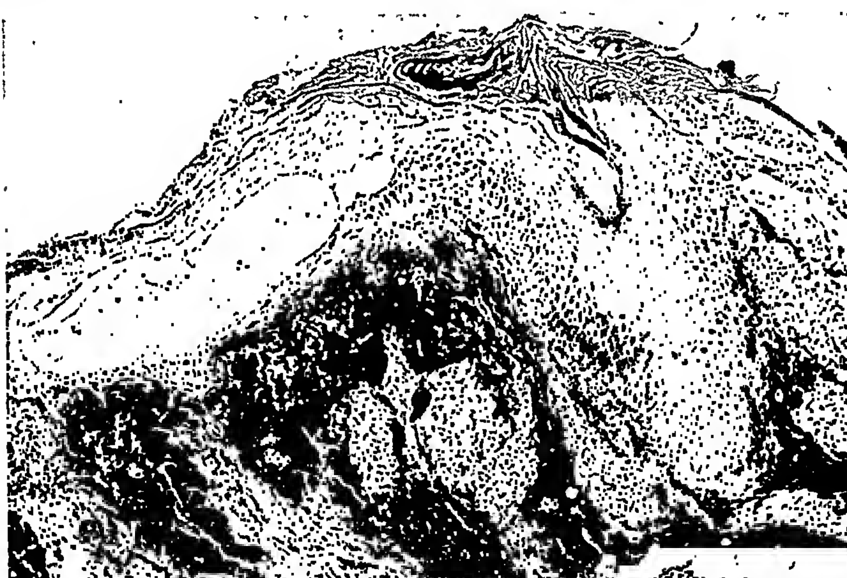

FIG. 3. EPITHELIAL REGENERATION OF DERMATOME DONOR SITE

This biopsy was taken on the 8th day after the removal of the skin from a site which was cooled for 5 days post-operatively at 60°F. Note the epithelial proliferation taking place centrifugally from the cut end of the hair follicle. Voerhoff's elastic tissue stain. Magnification × 120.

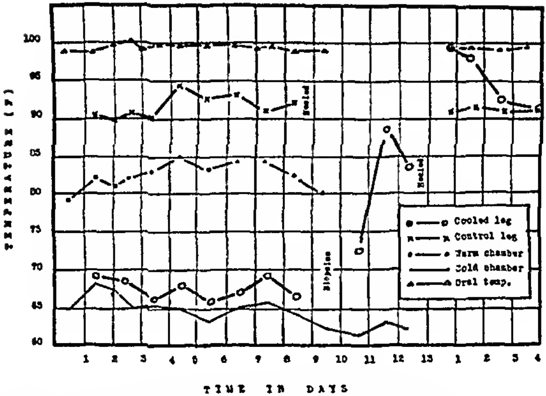

Fig. 4. Effect of Cold on Wound Healing

Graphical summary of the case included into table I (Experiment #1). Note hyperemia following temporary removal from cold chamber on the 10th day and following the final removal on the 13th day (see text).

Fig. 5. Effect of Cold on Wound Healing

Biopsy of the cold-treated donor site taken on the 10th
ously with biopsies shown in figs. 6 and 7. Note the adv
originating from the hair follicle on the right. Haemato
80.

is formed at the surface. The process of epithelization must begin very soon after surgical removal of the surface layer of the skin. The activity is noted in the exposed ends of the hair follicles and sweat ducts: there is a swelling of cells accompanied by "budding". When the free surface is reached there is a centrifugal proliferation of the epithelial cells which now become flattened; clinically the area appears to be dotted with numerous little islands of epithelium. A portion of such island is shown in fig. 3 and 5. These biopsies were taken from cold-treated areas but are practically identical with the usual appearance of untreated donor sites at about 5–6th post-operative day. By the 8–10th day the epitheli-

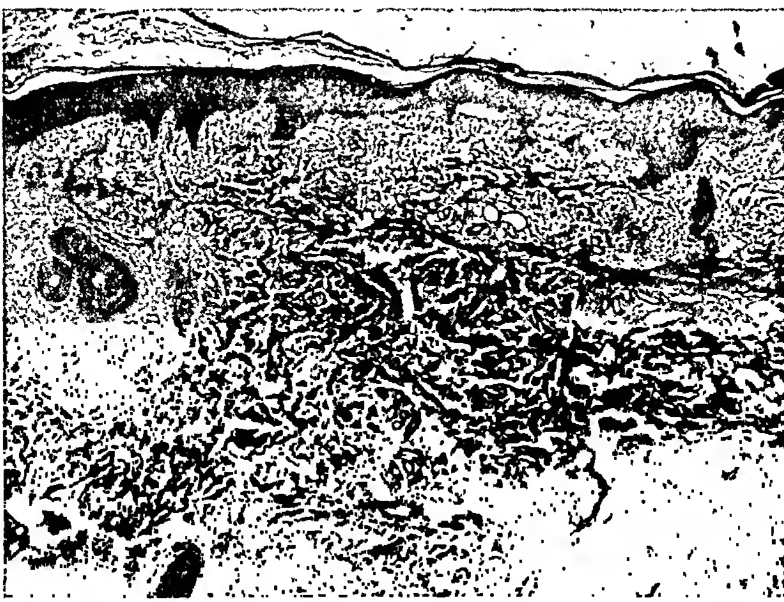

FIG. 6

Biopsy of the control area shown in fig. 14 (left thigh) taken simultaneously with the biopsies of cold treated donor site (figs. 5 and 7) on the 10th postoperative day. Haematoxylin-eosin. Magnification × 40.

zation of the surface is complete (fig. 6). The epidermis is flat and "young" and the horny layer is usually very thin. By about the 13th day the inflammatory reactions subsides, the epithelium differentiates into the usual layer and fibroblastic nature of the sub-epidermal layer becomes apparent (fig. 8). The appearance of the donor site at 52 days and at 6 months after the operation are shown in fig. 10 and 12.

Five experiments were performed on healthy adults between the ages of 17 and 28 years. Both thighs were used and symmetrically located areas were selected for donor sites. The observations are summarized in table 1; protocols of two of these cases follow.

Fig. 7

[illegible] ...m a dif[illegible] ...ery thi[illegible] ... 40.

Fig. 8. Biopsy of Control Donor Site on the 13th Postoperative Day. Haematoxylin-eosin. Magnification × 80

PROTOCOL No. 1

Experiment # 1, table 1

F. W., age 18, was admitted to the Royal Victoria Hospital for removal of naevus flammeus extending over the entire half of the face. Under general anaesthetic two uniform

TABLE 1—*Effect of Cold on Healing of Donor Areas*

EXP. NO.	AGE	SITE AND THICKNESS	AVERAGE TEMP. OF CHAMBER (F)	SKIN TEMP. OF COOLED AREA (F)	DAYS COOLED	TIME OF HEALING (in days)	
						Cooled	Control
1	18	Rt. Thigh (0.016 in.)	65°	72°–66°	13	13	9
2	26	Rt. Thigh (0.016 in.)	60°	65°–62°	5	12	8
3	25	Rt. Thigh (0.016 in.)	56°	61°–58°	12	14	10
4	17	Rt. Thigh (0.016 in.)	53°	70°–65°	9	13	9
5	26	Left Thigh (0.016 in.)	60°	64°–58°	3	8	8*

* This patient's left thigh was cooled for 3 days prior to removal of skin and subsequently was left at room temperature. (See protocol No. 2).

FIG. 9

Biopsy of the cold-treated donor site on the 13th postoperative day after continuous exposure to 65°F. Note the epithelial hyperplasia. Haematoxylin-eosin. Magnification × 80.

thickness (0.016) skin grafts were taken from the anterior aspects of both thighs and were used to replace the defect resulting from the excision of the naevus. The donor sites were dressed with a single layer of Bettman's gauze; the thermocouples were sutured directly to the donor area under the dressing. As soon as the patient recovered from anaesthetic her right leg was placed into the cooling chamber of the apparatus (fig. 1). The lower portion of the leg was covered with several layers of sheet wadding and other thick clothing so that

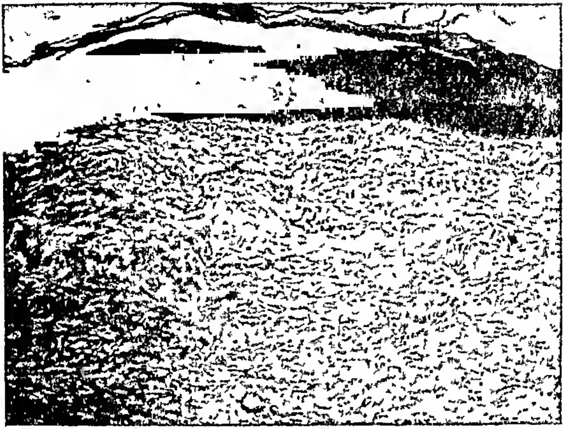

FIG 10 BIOPSY OF CONTROL DONOR SITE 52 DAYS POSTOPERATIVELY
The fine fibrillar structure is typical of freshly healed donor sites Haematoxylin-eosin Magnification × 120

FIG 11 COLD TREATED DERMATOME DONOR SITE
[illegible]
matoxylin-eosin Magnification × 120

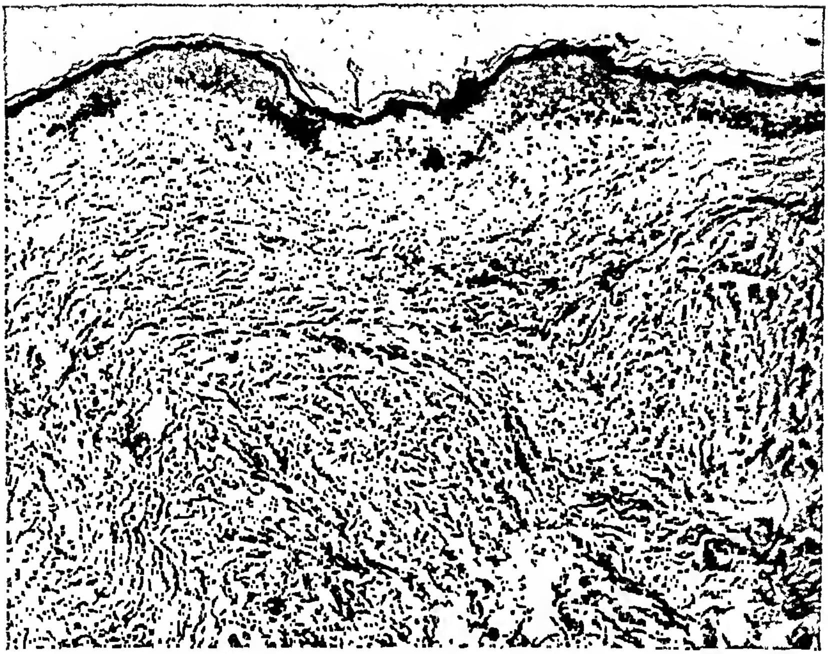

FIG. 12. CONTROL DONOR SITE
Biopsy taken 6 months postoperatively and simultaneously with biopsy shown in fig. 13. Haematoxylin-eosin. Magnification × 100

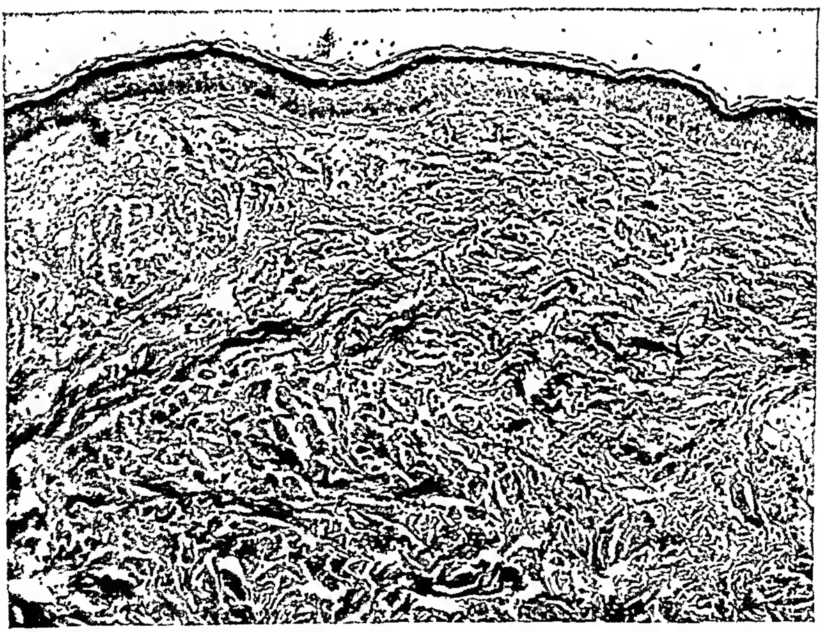

FIG. 13. BIOPSY OF COLD TREATED DONOR SITE TAKEN 6 MONTHS AFTER THE SKIN REMOVAL
Patient's thigh was subjected to 65°F. for 13 days. Compare with the control donor site shown in fig. 12. Haematoxylin-eosin. Magnification × 100.

only the donor area was exposed to the cold environment The left leg was placed in the "warm" chamber of the apparatus as control. The temperatures were recorded several times each day; notes were kept of the subjective sensations, clinical appearance, and of objective sensations in both donor areas

On the evening of the 9th post-operative day the control area was completely epithelized The next day the patient was taken to the operating room where under pentothal anaesthesia biopsies were taken from both areas (figs 5, 6 and 7) In fig 14 the two areas are shown just before the biopsies were removed The patient was allowed to recover completely from the effects of anaesthesia and was re-introduced into the temperature chambers about 4-5 hours after her removal earlier. The skin temperature of the cooled leg had become elevated in comparison with previous readings; the temperature varied between 72° and 89° F. for the next three days On the 13th post operative day the epithelization of the

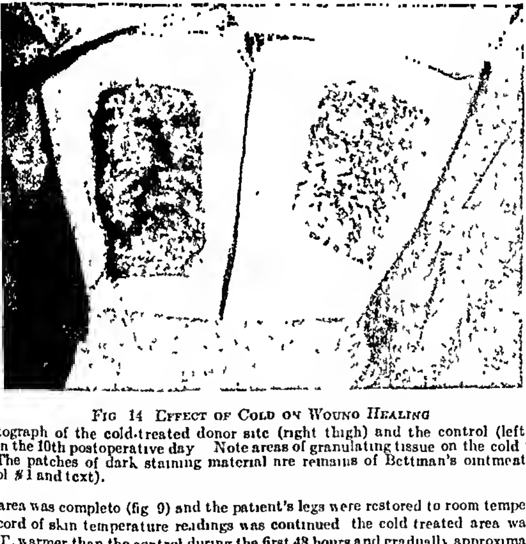

FIG 14 EFFECT OF COLD ON WOUND HEALING

Photograph of the cold-treated donor site (right thigh) and the control (left thigh) taken on the 10th postoperative day Note areas of granulating tissue on the cold treated site The patches of dark staining material are remains of Bettman's ointment (See protocol #1 and text).

cooled area was complete (fig 9) and the patient's legs were restored to room temperature The record of skin temperature readings was continued the cold treated area was from 8° to 6°F. warmer than the control during the first 48 hours and gradually approximated the temperature of the control leg over the next 48 hours (fig 4) The patient had no untoward reaction to the influence of cold at any time during the experiment The only sensation present in the cooled leg was that of moderate cold After exposure to the room temperature the patient stated that the leg which had little sensation while in the cold chamber, began to feel cold after about 45 minutes at room temperature, although there was obvious hyperaemia of the cooled area, the skin temperature being about 99° F The subsequent course of repair in the cold treated and control areas is shown in figs 10 to 13 The daily variations of temperatures are summarized in graphical form in fig 4 Clinically there was no greater amount of exudate in the cold treated leg, but it persisted for a somewhat longer time than that of the control At the time of healing of the control area the cold treated area was still "raw". However, the patient experienced less discomfort in the cold treated area throughout the period of cooling and subsequently

Microscopically, the amount of initial inflammatory reaction was more pronounced in the cold-treated area. At the time of complete epithelization of the control area (fig. 6), the cold-treated area was only partly epithelized, although some areas appeared to be more advanced than others (figs. 5 and 7). On the 13th day the healing of the cold-treated area was complete: the biopsy shows hyperplasia of epithelium and a considerable amount of perivascular clustering of inflammatory cells (fig. 9). Eight weeks later the cold-treated area showed a greater density of the sub-epidermal layer, more round cells and more marked perinuclear vacuolation of fibroblasts (figs. 10 and 11). At the end of six months post-operatively there was no significant difference between the cold-treated and control donor sites (figs. 12 and 13). Clinically the two areas appeared identical although the skin on the cold-treated site seemed to be somewhat thicker.

FIG. 15. PHOTOGRAPH OF COLD-TREATED DONOR SITE (RIGHT THIGH) AND THE CONTROL (LEFT THIGH) TAKEN ON THE 10TH POSTOPERATIVE DAY
This case is included in table 1 as Experiment 4. The cold treatment was continued for 12 days; final healing of the cold-treated area occurred on the 14th post-operative day.

PROTOCOL No. 2

Experiment # 2, table 1

M. C., age 26, was admitted to the Royal Victoria Hospital for correction of a defect of the face. Three days before operation the patient's left leg was placed into the cooling apparatus (fig. 1); the lower portion of the leg and foot was protected by thick layers of heavy clothing and only the distal half of the thigh was exposed to the cold. The temperature of the skin was recorded with the constantan-copper thermocouple. At the end of 72 hours the patient was taken out of the cooling apparatus; under spinal anaesthetic two sheets of skin (0.016 in.) were simultaneously removed with the dermatome from the antero-lateral aspects of the patient's thighs. The donor area on the left thigh extended partly over normal untreated skin which served as control, and partly over the "pre-cooled" area. Bettman's dressing was applied to all donor sites over the thermocouples which were sutured to the donor areas. The left donor area was dressed in the usual manner with the dry gauze dressings, followed by cotton waste and rubber sponges, and uniform pressure was applied with a roller bandage. The right donor area was not dressed beyond the Bettman's gauze. The patient's condition was excellent and at termination of operation her right thigh was

FIG. 16. PHOTOGRAPH OF COLD-TREATED DONOR SITE (RIGHT THIGH) AND THE CONTROL (LEFT THIGH) TAKEN ON THE 9TH POST-OPERATIVE DAY

The [illegible] the ink line on the left was pre-cooled for 3 days before operation.

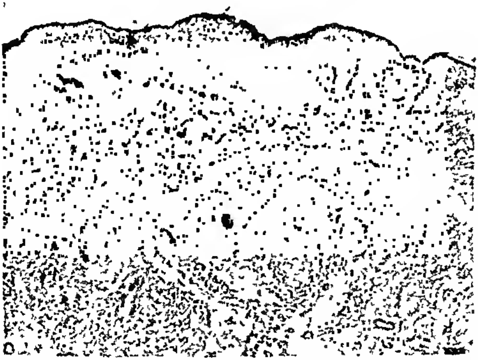

FIG. 17. BIOPSY OF PRE-COOLED AREA SHOWN IN FIG. 16 (DISTAL HALF, LEFT THIGH) TAKEN ON THE 8TH DAY AFTER REMOVAL OF THE SKIN

Note the hyperplasia of the regenerating epithelium and the perivascular clustering of inflammatory cells. Compare with control in fig. 18 and to fig. 21. *Haematoxylin-eosin.* Magnification × 50.

Fig. 18

Biopsy of the control area (fig. 16, proximal half; left thigh) taken on the 8th postoperative day, shortly after complete epithelization. The debris at the surface is the remains of the exudate mixed with Bettman's ointment. Haematoxylin-eosin. Magnification × 50

Fig. 19. Effect of Cold on Wound Healing

Biopsy of the cold-treated donor site taken on the 8th postoperative day simultaneously with biopsies shown in fig. 17 and 18. The donor site was cooled for 5 days after removal of the skin. Note the proliferation of the epithelium from the hair follicle. The advancing sheet of thin epithelial cells can be seen at the surface of the section. (See protocol #2 and text). Haematoxylin-eosin. Magnification × 50.

FIG. 20. NORMAL SKIN GRAFT

This biopsy was taken from a skin graft (0.018 in.) 14 days after grafting. Note the character of epithelium and the density of the sub-epithelium and deeper layers of the dermis. Compare with the "dermigraft" shown in fig. 21. Haematoxylin-eosin. Magnification × 50.

FIG. 21. EPITHELIAL REGENERATION IN A "DERMIGRAFT"

A dermigraft is produced by resplitting an ordinary dermatome skin graft and transplanting the inferior portion containing no surface epithelium to a denuded area. The regeneration of epithelium proceeds from the cut ends of hair follicles and sweat ducts and thus is qui[illegible]ordinary donor areas. Note the hyperplasia of epithe[illegible]pithelial layer. Compare with figs. 17, 18 and 20. [illegible] × 50.

FIG. 22

Biopsy of the pre-cooled donor site taken on the 13th postoperative day shortly after complete epithelization of the cold-treated area shown in fig. 23. (See protocol #2 and text) Haematoxylin-eosin. Magnification × 80.

FIG 23

Biopsy of the cold-treated donor site taken on the 13th postoperative day and simultaneously with the biopsy shown in Fig. 22. The complete epithelization of the area was noted clinically about 12 hours earlier. (See protocol #2 and text). Haematoxylin-eosin. Magnification × 80.

inserted into the cooling apparatus with the lower leg protected from the cold in the usual manner The right donor area was maintained in the cold apparatus for 5 days At the end of that time the right leg was removed to room temperature and a pressure dressing identical with that of the left leg was applied The skin temperature readings were continued On the 8th post operative day both the "pre-cooled" and the control areas were completely epithelized· photographs (fig 16) and biopsies (figs 17, 18, 19) were taken 12 hours later On the 12th post-operative day the cooled donor site was completely epithelized, biopsies were taken shortly after that time (figs 22 and 23) The patient remained quite comfortable throughout the experiment

The graphical summary of the procedures used in this case and the daily variations of the temperature of the donor sites and of their respective environments are presented in

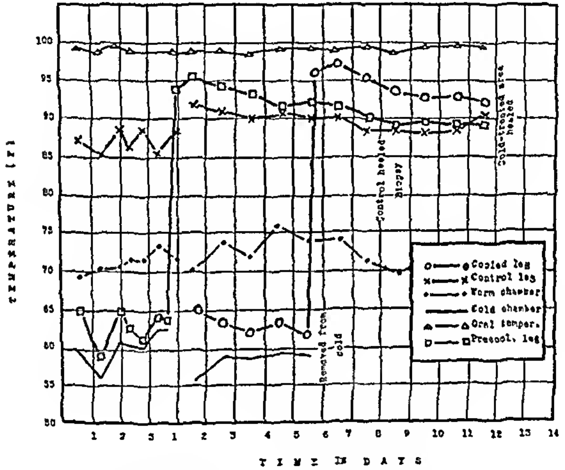

FIG. 24. EFFECT OF COLD ON WOUND HEALING

Graphical summary of the case p ... of skin temperature) following removal from cold Skin temperature was recorded with constantan copper thermocouples

fig 24 At the end of the period of cooling the temperature of cold treated site rose considerably higher than the temperature of the control site, and persisted for several days. A similar rise of temperature beyond that of the control (although to a lesser degree) followed cooling of the thigh for 3 days prior to removal of the skin ("pre cooled" area, fig 24). Following removal from the cold chamber the cold treated donor site had a greater amount of surface exudate than the control donor area

Microscopically, the epithelization was complete in the biopsies taken of the control area on the 8th post operative day (fig 18) The cold-treated area was in the "inflammatory phase": both the cellular and unformed exudates were much more pronounced than in the control (fig 19). Biopsies of the donor sites on the 13th day revealed complete epithe-

lization of the cold-treated area; the epithelium was in the stage of hyperplasia (fig. 23). The "pre-cooled" donor site is shown in figs. 17 and 22. On the 8th day the epithelization of the latter was complete but the epithelial hyperplasia was marked and mitotic figures were abundant. The inflammatory reaction was more pronounced than in the control; the fibroblastic proliferation was not greater, however. Biopsy on the 13th day showed less difference from the control, though the inflammatory reaction was still more marked in the pre-cooled area. At the end of 6 months there was no significant difference either grossly or microscopically between the cold-treated and the untreated donor areas.

DISCUSSIONS

The process of tissue repair is a continuous interplay of cell migration combined with the structural synthesis involving a sequence of biochemical reactions. The rate of both components of this process is influenced directly by the temperatures of the environment. Within a certain range of "moderate" temperatures, either cold or warm, the sole effect will be either a reduction or an increase in the rate of these reactions of repair. However, drastic reduction or increase of the temperature brings in its wake a whole sequence of changes which complicate and interfere with the optimal process of wound healing.

The ultimate aim of any repair process, teleologically speaking, is restoration of complete function of the part. Three simultaneous processes take place in wound healing and in repair of injured tissues namely, the removal of non-viable and "foreign" material by a process of inflammation, restoration of the continuity of tissue, and filling up of the defects created by the injury. The first entails invasion with several types of inflammatory "demolition and transportation" cells; the second entails, in the skin, proliferation of epithelium; the third involves fibrous tissue formation. Other concommitant reactions taking place during the period of wound healing have no apparent purpose, and often interfere with the general plan of wound healing.

The sequence of regenerative processes in the dermatome donor area has been described above. Similar events occur in the re-epithelization of a "dermigraft" (fig. 21). A dermigraft is a skin graft from which the epithelium has been removed by re-splitting it with a dermatome. It was described by Zintel as a means of increasing the yield of limited donor sites in severely burned patients (20). We carried out observations on the healing of dermigrafts with the purpose of studying the effect of a temporarily interrupted blood supply on the repair processes of donor areas. The sources of epithelium in a dermigraft are the cut ends of the hair follicles and sweat ducts. Thus the regeneration of surface epithelium and fibrous tissue formation is almost identical with that of a donor area. However, in the dermigraft these processes must take place under the added burden of a regenerating blood supply. Nevertheless, the healing of a dermigraft is completed only a few days later than that of a donor site. The second reparative process—that of proliferation of epithelium, appears to be more pronounced in the healed dermigraft. (Compare fig. 21 with fig. 8)

Another phase of the behaviour of the three processes of wound healing enumerated above is their response to the influence of cold. The observations recorded in our series of cases presented the results of study of the processes of

epithelization and fibrous tissue formation under different temperatures and duration of exposure but under controlled conditions Combining the cold-treated and the control areas into tabular form (table 2), it is apparent that in the range of temperature between 82° and 53° F the time required for complete epithelization of the area is inversely proportional to height of the temperature and directly proportional to the time of exposure In the range of "cold" temperatures (65° to 53° F) the delay of complete epithelization was about 3 to 4 days for the standard dermatome donor area as compared with the controls

The delay in the rate of epithelization appeared to be more pronounced than that of the fibrous tissue formation This is consistent with the gradation of temperatures which is coolest at the interphase between the environment and the body, precisely where epithelial proliferation takes place, and becomes "warmer" as the deeper layers are reached We have not noticed an increased amount of surface exudate on the cooled donor sites, although that might be

TABLE 2—*Effect of Temperature of the Environment on Healing of Donor Areas*

NO	AGE	SITE AND THICKNESS	AVERAGE TEMP OF ENVIRONMENT (F)	SKIN TEMP OF THE DONOR SITE (F)	DURATION OF EXPOSURE	TIME OF HEALING (Days)
1	17	Rt thigh (0 016 in)	53°	65°–70°	9*	13
2	25	Rt thigh (0 016 in)	56°	58°–61°	12*	14
3	26	Rt thigh (0 016 in)	60°	62°–65°	5*	12
4	18	Rt thigh (0 016 in)	65°	66°–72°	13	13
5	26	Left thigh (0 016 in)	72°	88°–92°	8	8†
6	25	Left thigh (0 016 in)	76°	90°–95°	10	10
7	17	Left thigh (0 016 in)	78°	87°–92°	9	9
8	18	Left thigh (0 016 in)	82°	90°–91°	9	9

* At the end of this period the patient's limb was returned to room temperature until the time of healing

† Pressure dressing as well as Bettman's gauze was used on the donor area in this patient

anticipated in view of the changes in the permeability of the vessels under the influence of prolonged moderate cooling An increased quantity of fibrinous oedema was noted microscopically in the cold treated areas and persisted for several weeks (figs 9 and 11), it is not conspicuous in the biopsies taken 6 months after experimental cooling (fig 13) The delay in healing has been observed by several workers Crossman and Allen stated that temperatures of 40° F. and lower suppress the metabolism so much that healing is virtually prevented Moreover, in order to avoid gaping of the wound edges following amputation with the aid of refrigeration, the sutures had to be left in for 5–6 days longer than in the untreated wounds (6) Davis observed a latency of epithelial growth of a week or longer in previously refrigerated tissue, although blood supply became established and "take" occurred (8) Matthews thought that refrigeration of skin accelerated fibroblastic proliferation thus speeding up the rate of "take" and of vascularization when applied to wounds (9) However, Davis

reported that growth of refrigerated grafts seemed slower than the growth of untreated tissues (8). We have noted the "lag" that follows grafting of chilled or frozen skin, but do not consider it to be intrinsically a "delay" of healing (10). Whereas moderate cooling delays healing by virtue of retarded cellular metabolic activities, prolonged refrigeration and freezing of skin causes death of cells through the influence of cold. Before healing or a "take" can occur the replacement or removal of the damaged and destroyed portions has to take place; consequently there is interference with the repair process.

The role of vascular elements in the delay of healing which follows the exposure of donor site to the influence of moderate cold is difficult to determine. We have stated above that there was no marked increase in the amount of exudate observed on the cold-treated area, although microscopically the increased amount of fibrinous oedema was noted and, for a time the amount of fibrous tissue also. The vasodilatation that followed exposure to moderate cold was quite apparent clinically and was recorded by an increase of skin temperature; but microscopically the vasodilatation was less conspicuous. However, the hyperemia due to vasodilatation was observed even after a short exposure to only very moderate cold (11, 12, 14, 2). Landis demonstrated the phenomenon by recording the increase of the intercapillary pressure; it appeared a few minutes after initiation of cooling and before the termination of the cold stimulus (14). In our experiments the superficial capillaries were physically removed with the layer of the skin, and the hyperemia which followed termination of cooling was due to dilatation of venular and arteriolar plexuses. Other data based on the study of the vascular response of normal skin and healed donor sites tends to support this observation (10). In our series of experiments the degree of hyperemia was proportional to the degree of cold and to the duration of the stimulation (fig. 4 and 24). The mechanism of hyperemia production has not been well understood. Lewis (13) regarded it as a protective mechanism against excessive cooling. Other investigators considered that the response was due to the influence of accumulated tissue metabolites (15). The discussion of this extremely interesting phenomenon as well as other implications will be presented in the subsequent paper (10).

Pre-cooling of the area prior to the removal of the skin was carried out in one case. This particular experiment was attempted because it has been claimed that tissue irritation and hyperemia speed the processes of healing (21). Exposure of skin to even moderate temperatures is followed by marked hyperemia which persists for a considerable period of time depending upon the degree and length of cooling. We removed the skin at the height of hyperemia which followed the exposure of the patient's thigh for 72 hours to 60° F. (See fig. 23). The donor site was subsequently treated with Bettman's gauze and pressure dressing identical with the untreated control area. Healing occurred on about the same time as the control and grossly there was no difference between the two areas, either in appearance or in texture; the microscopic differences are ncluded in protocol # 2 The only conclusion that we can draw from this ob-

servation, is that exposure of skin to 60° F for as long as 72 hours prior to removal of skin does not delay the healing of the donor area

Our observations based on the treatment of donor sites under experimental and non investigative conditions show, that application of a pressure dressing, other things being equal, speeds up spontaneous epithelization of the donor area, reduces the amount of exudate and keeps in check the sub-epithelial fibrosis The principle of pressure dressing has been advocated and followed by many workers, and its utilization in the field of plastic surgery and for the treatment of burns and other injuries has been firmly established (16, 17, 18, 19) We concur with the recommendations of Koch (22) that clean undamaged cells should be not disturbed by frequent dressing, permitting utmost regeneration However, this procedure does not solve the still existing problem of treatment of "mixed" burns where some remnant of epithelial sources are intermingled with the areas of complete destruction of skin Such burns are invariably contaminated and sooner or later become infected Because the methods of determining the depth of tissue destruction immediately after burning are inadequate, it is not possible to say how much of the potentially regenerative tissue in the areas of only partial destruction has been prevented from regeneration by the presence of debris and infection We have pointed out earlier that removal of the damaged tissue and combating of foreign elements constitute the integral part of wound healing In extensive burns the amount of destroyed tissue is so great that the body's mechanism of repair cannot cope with it Moreover, the nature of the dead tissue is such that it resists both the action of the body enzymes and penetration by the inflammatory cells

There have been many advocates of cold for the treatment of burns Our observations based upon the experiments with laboratory animals (2) and experimental and clinical study of the effect of cold in man, do not bear out the enthusiasm of these investigators Application of moderate cold delays healing even under optimum conditions of repair and regeneration It is difficult to combine a pressure dressing with the application of cold and consequently the pressure has to be dispensed with The degree of cold required to check bacterial growth and disintegration of tissue imposes additional damage on the part which is already injured by heat

CONCLUSION

1 Moderate cooling of dermatome donor sites (0 016 in) immediately after removal of skin grafts delays the rate of epithelization In the range of the temperatures studied (65° to 53° F) the delay is directly proportional to the degree of cold and to the duration of exposure

2 The fibrous tissue formation is not similarly affected and appears to be increased, at least for the first few weeks after cooling

3 Pre-cooling of the area of skin prior to removal of the skin graft does not delay the rate of epithelization

4 The optimum temperature of the environment for healing appears to be somewhere between 70° and 80° F However, most rapid epithelization occurs

with application of pressure dressings; the temperature at the surface of such donor sites is 90° to 95° F.

5. The use of cooling as the treatment of burns is not advantageous since it delays healing and entails dispensing with pressure dressing. The degree of cold required to check bacterial growth and the disintegration of damaged tissue imposes further injury.

SUMMARY

1. The suitability of dermatome donor sites for the study of the effect of cold on wound healing in man is discussed.

2. The details of the methods of study and the apparatuses constructed for the investigation of the influences of reduced temperatures on healing of donor sites is described.

3. The sequence of events in the spontaneous healing of untreated donor sites is described and the various stages are illustrated with photomicrographs of the biopsies.

4. The experimental observations are presented in tabular form. The details of two of the cases are given in form of protocols; photographs and photomicrographs of the biopsies of the various stages are included.

5. Gross and microscopic changes taking place in healing of the cold-treated donor sites are described and compared with those of the untreated controls.

6. The interaction of various components of wound healing and regeneration of different elements of skin are considered in relation to the range of reduced temperatures studied and to the duration of exposure.

7. The effect of pressure dressing on the rate of spontaneous epithelization of donor sites and on the wound healing of areas injured by cold or heat is discussed.

8. The need of caution in the application of cooling as a treatment for burns is emphasized.

Acknowledgment. We wish to thank Dr. G. Lyman Duff for making available the facilities of the Department of Pathology and for helpful advice. We are indebted to Dr. K. A. Evelyn for the construction of complex electrical equipment, and to the Coca Cola Company of Canada and the Electrolux Company of Canada for the loan of equipment used in the construction of the refrigeration apparatus.

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ANAPHYLAXIS AND THE HOMOTRANSPLANTATION OF SKIN*

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Numerous theories have been advanced to explain the failure of skin homotransplantation, among which is the idea that the skin of the host becomes sensitized to the skin proteins of the donor. Underwood (1) first advanced this idea as the result of observations on a patient who had been burned severely in a kerosene explosion. Underwood grafted skin from 17 donors to this patient; all of these grafts took readily and the growth was evident as long as 20 days after grafting. At this time, Underwood grafted a second area. This new graft did not take and moreover the old grafts began to melt away. Concomitant with this reaction a hematuria developed and the patient's pulse became weak and irregular. Underwood believed that these were anaphylactoid phenomena resulting from previous sensitization to this skin. Holman's (2) observations seemed to support this theory. He reported a case in which generalized exfoliative dermatitis developed following repeated homotransplantation of the skin. When he removed these grafts by curetting, the dermatitis improved rapidly and cure was complete within a month.

Experimentally, Martin and Keyes (3) found that guinea pigs could be sensitized to homologous lens protein. On the other hand Fleisher (4) could find little or no difference after transplantation of guinea pig kidney to previously passively immunized animals. There was no difference between these and the uninjected pigs in the degree or rate of regeneration of the tubules, degree of connective tissue reaction or the rate of invasion by the connective tissue cells. As yet however there is no experimental evidence showing that sensitivity to skin of homologous species can be produced.

The above observations, particularly those of Martin and Keyes, suggested the need of further study to determine whether the failure of homotransplantation of skin was due to development of sensitivity to the transplanted tissue. The present report concerns the results of such a study.

EXPERIMENTAL

Attempts were made to produce anaphylaxis in guinea pigs by injection of extracts of skin into animals that had been injected with such extracts previously. Approximately 15 gram portions of skin free from hair were excised from each guinea pig. 5 cc. of normal salt solution was added for each gram of skin, and the mixture ground repeatedly in a meat grinder for twenty minutes. The solid part was removed by centrifugation. The supernatant fluid was pipetted off, and sterilized by merthiolate in parts 1:10,000. Similar extracts were prepared

* Work done under a grant from the Institute of Medical Research, Christ Hospital, Cincinnati, Ohio.

from six guinea pigs. The approximate protein content was determined by the Etxon quantitative method, and found to be between 60–70 mg. per cent.

The technique used in the attempted sensitization and shocking of the guinea pigs was as follows: 3 injections of .1 cc. of the extract were made subcutaneously on alternate days. Fourteen days after the last injection, an attempt was made to shock these animals by injection of 1 cc. of the extract into the jugular vein. A total of 48 animals were so treated. None of these pigs showed the slightest anaphylactoid response. Therefore, 1 cc. of the homologous extracts was again injected intravenously, this time fourteen days after the previous shocking dose. This also failed to produce anaphylactoid reaction.

That this procedure was effective in sensitizing animals to extracts of heterologous skin is shown by the following experiments. An extract of rabbit skin was prepared according to the above procedure and eleven guinea pigs were sensitized in the manner described. Fourteen days after the last sensitizing dose, 1 cc. of the extract of rabbit skin was injected into the jugular vein. Of the eleven animals so treated 6 suffered fatal anaphylactoid shock, and the remaining animals suffered severe shock.

DISCUSSION

The cause of failure in homotransplantation of skin in man is still undiscovered. Reports from competent observers such as Davis (5) show that occasionally in man there have been successful cases of homotransplantation of the skin. Shank (6) reports a case where seventeen donors were tried before a successful one was found, and that he was used repeatedly later for grafting. It may be that there exist in man skin groups which differ from the blood groups, and these determine whether or not the grafts will take. The experiments reported here in this paper suggest that the cause of failure is not due to an anaphylactic reaction. Blumenthal's (7) work on blood cell changes after transplantation of skin agrees with the microscopic observations of Loeb (8). They report that after homotransplantation there is an increase in the lymphocytes both in the blood stream and around the graft. This does not correspond to our present idea of anaphylactic reactions, which call for a marked eosinophilia both locally and systemically following the injection of a foreign protein. There is a possibility that the reactions reported by Underwood and Holman may be due to the absorption of protein breakdown products of the grafts. One must also recall that in both cases reported severe debilitation was present.

SUMMARY

The guinea pig cannot be sensitized to homologous skin proteins.

The reactions following skin grafting in man were probably not due to the sensitization to homologous skin proteins.

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Numerous theories have been advanced to explain the failure of skin homotransplantation, among which is the idea that the skin of the host becomes sensitized to the skin proteins of the donor. Underwood (1) first advanced this idea as the result of observations on a patient who had been burned severely in a kerosene explosion. Underwood grafted skin from 17 donors to this patient; all of these grafts took readily and the growth was evident as long as 20 days after grafting. At this time, Underwood grafted a second area. This new graft did not take and moreover the old grafts began to melt away. Concomitant with this reaction a hematuria developed and the patient's pulse became weak and irregular. Underwood believed that these were anaphylactoid phenomena resulting from previous sensitization to this skin. Holman's (2) observations seemed to support this theory. He reported a case in which generalized exfoliative dermatitis developed following repeated homotransplantation of the skin. When he removed these grafts by curetting, the dermatitis improved rapidly and cure was complete within a month.

Experimentally, Martin and Keyes (3) found that guinea pigs could be sensitized to homologous lens protein. On the other hand Fleisher (4) could find little or no difference after transplantation of guinea pig kidney to previously passively immunized animals. There was no difference between these and the uninjected pigs in the degree or rate of regeneration of the tubules, degree of connective tissue reaction or the rate of invasion by the connective tissue cells. As yet however there is no experimental evidence showing that sensitivity to skin of homologous species can be produced.

The above observations, particularly those of Martin and Keyes, suggested the need of further study to determine whether the failure of homotransplantation of skin was due to development of sensitivity to the transplanted tissue. The present report concerns the results of such a study.

EXPERIMENTAL

Attempts were made to produce anaphylaxis in guinea pigs by injection of extracts of skin into animals that had been injected with such extracts previously. Approximately 15 gram portions of skin free from hair were excised from each guinea pig. 5 cc. of normal salt solution was added for each gram of skin, and the mixture ground repeatedly in a meat grinder for twenty minutes. The solid part was removed by centrifugation. The supernatant fluid was pipetted off, and sterilized by merthiolate in parts 1:10,000. Similar extracts were prepared

* Work done under a grant from the Institute of Medical Research, Christ Hospital, Cincinnati, Ohio.

AMPUTATION VERSUS TRANSPOSITION OF GLAND AND NIPPLE IN MAMMAPLASTY

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Any surgical procedure for repair of a breast deformity should rest on a sound anatomical and physiological foundation The following are therefore essential conditions of an acceptable mammaplasty

(1) Injury to the gland and galactophorous ducts should be avoided or kept to a minimum in order to preserve the mammary function

(2) When extensive reduction of hypertrophied tissues is required, the main blood supply of the parts must be carefully retained in order to prevent necrosis of the skin and glandular structures

(3) The breast must be shaped harmoniously in all dimensions

(4) Scars should be as slight as possible and adequately concealed

MAMMECTOMY WITH FREE TRANSPLANTATION OF NIPPLE

The procedure of amputation with resection of the nipple for repair of benign hypertrophies violates most of these conditions It is indicated only in huge hypertrophies with pronounced stasis, requiring extensive resections, and even in such cases a less crippling procedure which preserves the nipple can often be successfully employed (1)

Mammectomy with free transplantation of the nipple was suggested in the early 1920's by Dartigues (2, 3) who claimed to be its originator A similar claim is made by Thorek (4)

Description of Method

The usual procedure involves the following steps (fig 1)

The areola including the nipple is circumcised and detached from the subjacent structures by sharp dissection Crescent shaped horizontal incisions are then made on the anterior aspect of the breast and along the submammary fold, through which all or most of the gland is excised

A raw circular area is prepared for the nipple in a new location by a split skin dissection, leaving a layer of dermis and avoiding exposure of fatty tissue The free nipple areola graft is then sutured to the raw area on the anterior flap

Analysis of Procedure

From the claims made for this procedure, it might be inferred that the full structure of the nipple is transplanted and continuity of the ducts preserved One report on histological findings in a freely transplanted nipple states, "I came to the conclusion that I was confronted with true glandular regeneration possible because of the transplantation of the nipple reestablishing communication with the galactophorous canals" (4)

In my opinion, there is no foundation for claims that, following transplantation of the nipple, communication of the severed galactophorous ducts can be re-established and sufficient glandular regeneration occurs for functioning. *It is common knowledge that severance of the nipple and its terminal glandular endings from the excretory milk ducts is final: the continuity of the ducts cannot be restored.* Physiologically, this is tantamount to necrosis of both nipples.

I have previously pointed out (5) that a *nipple in toto* cannot be transplanted freely: the nipple-areola graft "takes" in the same manner as any other free full-thickness graft, but not as a composite *glandular* graft. "The indisputable proof of histological presence of ductal, nervous and other components" (6), cited by

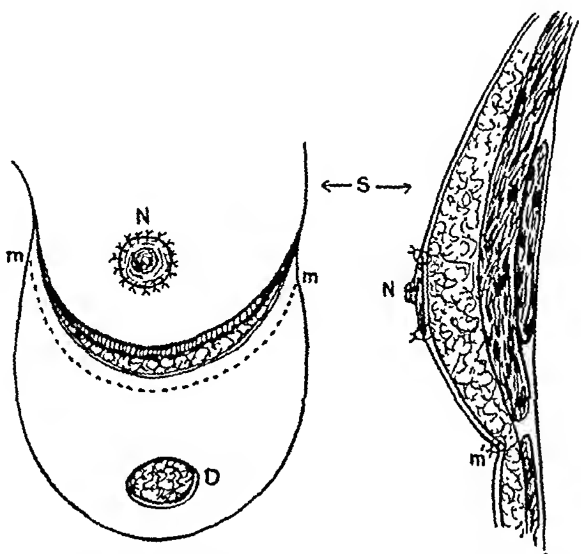


Fig. 1. Mammectomy with Free Grafting of the Areola and Nipple

D.—Defect following detachment of areola and nipple by sharp dissection; N,—Free nipple graft sutured to a circular surface on the anterior flap following split skin dissection. S.—Horizontal flap sutured in the submammary fold (m) after total or subtotal excision of the gland.

the exponent of this method, consists merely of the presence of the usual terminal endings in the full-thickness covering of the area.

The sacrifice of nipple and glandular function is supposedly justified by the assumption that the hypertrophic breast is functionless and therefore not worth preserving. Although lactation is usually absent in the rare virginal and gravid hypertrophies, it is present in the majority of cases of the common fatty type. There are many case histories on record (including my own three) in which mothers were able to nurse their infants successfully following properly performed mammaplasty (7, 8, 9). Like Ragnell (9), Gillies (10) and many others, I cannot subscribe to a method which makes no attempt to preserve the function of the breast, particularly in unmarried girls and women who have not yet borne children.

Amputation deprives the breast of other important physiological attributes, namely, *normal sensitivity and contractility* of the nipple. In a freely grafted nipple, *these either remain absent or are greatly reduced when they do return*[1] Inclusion in the graft of some smooth muscular tissue may contribute to the preservation of contractility of the nipple to some degree

Esthetically, full preservation of the blood and nerve supply, glandular system, musculature, and *continuity of the galactophorous ducts in the nipple*, all contribute to retention of the youthful characteristics of the breast Even with a complete 'take' the freely grafted nipple does not satisfy these requirements Moreover, the formation of a horizontal flap and the sacrifice of most of the gland produce a flatness incompatible with good configuration of the breast (fig 2)

Fig 2

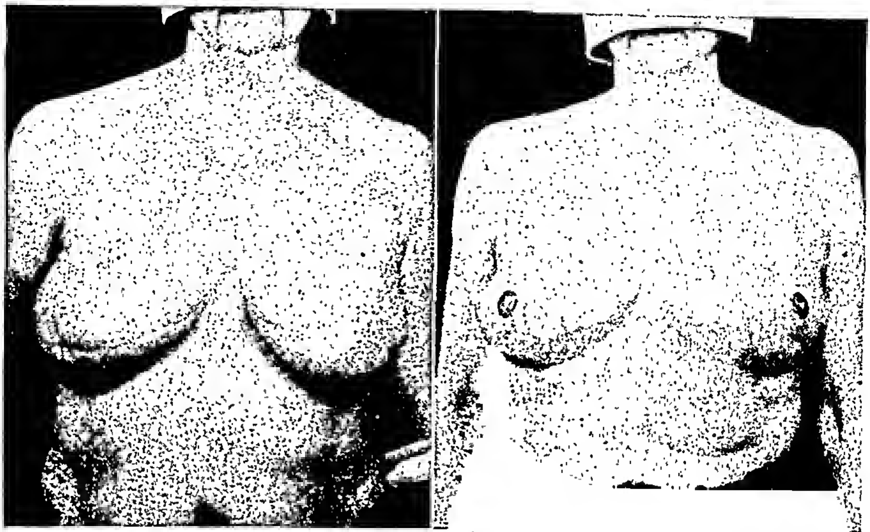
...h free trans ... Note bilat ... take'' of the graft is assured when a layer of derma is left intact under the transplant Flatness of breast is a usual occurrence in this method

In rare cases of huge hypertrophy, where transposition may be contraindicated because of the required extensive excision, the author's subtotal mammectomy with preservation of the nipple can be done in one stage (1) The excess breast tissue is removed from the posterior surface of the gland, and the superfluous skin excised along the midline and submammary fold The nipple itself is not disturbed and remains attached to the galactophorous system

[1] Professor Sanvenero-Rosselli (Director, Sarfatti Reconstruction Hospital, Milan Italy) wrote in a personal communication, March 1947 "I am not in favor of amputation of the gland with free transplantation of the nipple in breast reconstruction for the following reasons·

1. The procedure is unnecessarily mutilating ... In Europe this method, which was devised by Dartigues never became popular; Dartigues himself in his later years seldom practiced it

2 The grafted nipple even when it heals well usually remains inert and insensitive, whereas following Biesenberger's and other transposition procedures, contractility and sensitivity are preserved or regained early".



A B

FIG. 3

A.—Postsurgical deformity of breast following subtotal mammectomy with amputation of nipple in a woman aged 48, done 12 years previously, for benign breast hypertrophy. B.—Condition following secondary mammaplasty consisting of mastopexy and adjustment of skin flaps along vertical and submammary incisions. The camouflaging of the nipple done by tattooing a cone-like protruberance of the central segment see (fig. 4).

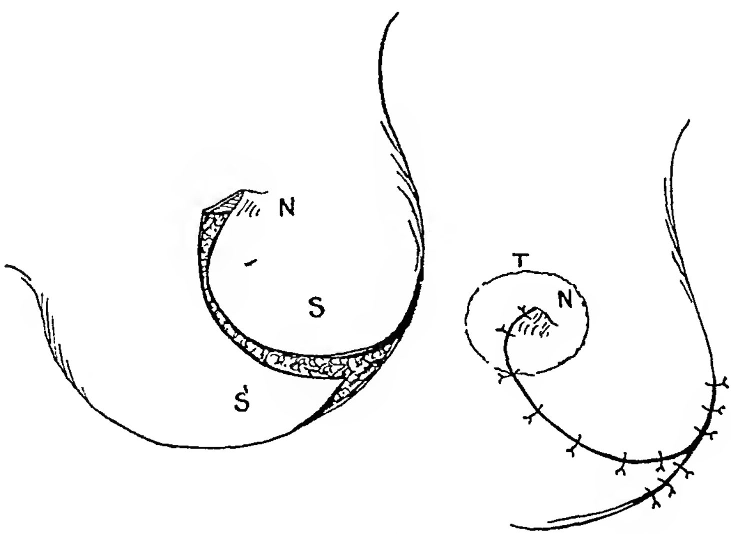


FIG. 4

Author's procedure for camouflaging postsurgical loss of nipple and reconstruction of excessive width of breast in secondary mammaplasty. Vertical curved skin excision and mobilization of flaps SS[1], along submammary line to produce folding and skin elevation in nipple area (N); the latter is subsequently tattooed (T).

Amputation is indicated in those rare cases of extreme enlargement in which the nipple is involved with edema and stasis. Here, following mammectomy

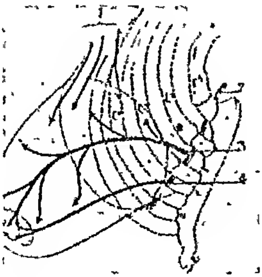


Fig. 5

[illegible] vascularization of t [illegible] ually perforating branche [illegible] d and nipple. C1, C1, C1, [illegible]

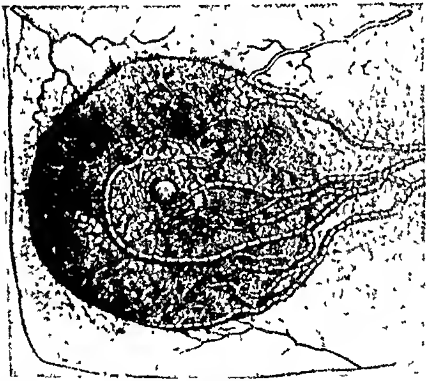


Fig. 6

Distribution of lymphatic vessels on the anterior surface of left breast (Sappey). A subareolar lymphatic plexus around the nipple with main lymphatic vascular trunks drain- [illegible] directed toward the axilla The lym- [illegible] to the peri-areolar arterial and venous [illegible] breast including the lymphatic trunks as in procedure of Biesenberger (19) will often interfere with adequate drainage of the gland, causing stasis with cyanosis of nipple and possible necrosis.

with excision of nipples, an elevation can be created by skin plasty at the site of the nipple and the area tattooed (figs. 3, 4).

Sound principles of mammaplasty were first postulated (1903–1911) by Guinard, (11), Morestin (12, 13) and Villandre (14) who devised the methods of transposition and discoid resection for breast reconstruction. Dufourmantel (15) and Passot (16), pupils of Morestin, and later Axhausen (17) and Lotsch (18) reported the procedure of transposition with none or few modifications.

In all their methods, except the discoid resection (Morestin), slight consideration was given to the factors of blood supply and location of glandular excisions;

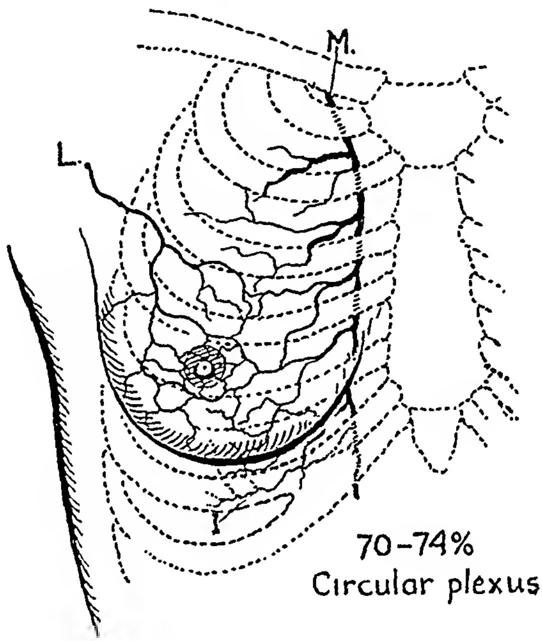


FIG. 7

Diagram of main vascular pedicles of the breast on the topography of which are based the sound surgical concepts of mammaplasty (22).

L.—Thoracic lateral artery. M.—The internal mammary artery with its perforating branches. I.—Intercostal arteries (branches of the internal mammary artery) penetrating the posterior surface of the breast. Deeply located arteries are represented by dotted lines. The ramifications of the main arteries form a complete ring around the nipple (circular plexus in 70–74 per cent of cases). This type of vascularization assures maximum blood supply and is *safest from the viewpoint of possible necrosis. Resection of the external half* of the breast, sacrificing the thoracic lateral artery, *will not compromise here the vitality of the central portion of the gland* and nipple.

However, *extensive removal from upper quadrants may even in favorable cases interfere with vascularization of the upper half of the nipple, producing a border line necrosis.*

one stage was thought adequate for reconstruction in most instances. This was especially true in removal of the external half of the breast which was carried out with complete disregard of vascularization (19).

Role of Blood Supply

This neglect of the essential blood supply of the gland frequently caused postsurgical complications, particularly in large hypertrophies where extensive re-

sections were required. Erroneous conceptions (20) reprinted from one textbook to another, were responsible for the outlining of glandular pedicles with inadequate circulation, sometimes resulting in necrosis.

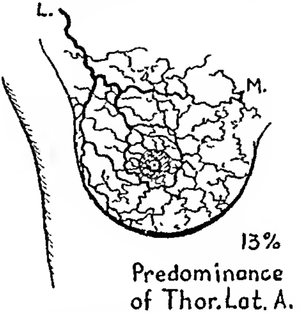


Fig. 8

Predominance of the thoracic lateral artery which is encountered in 13 per cent of cases (22 & 23). Resection of the external half of the breast in this instance *may sufficiently disturb the blood supply of the gland to bring obout necrosis.*
L.—External lateral artery. M.—Internal mammary.

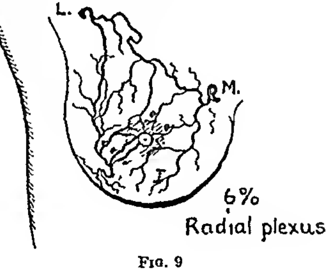


Fig. 9

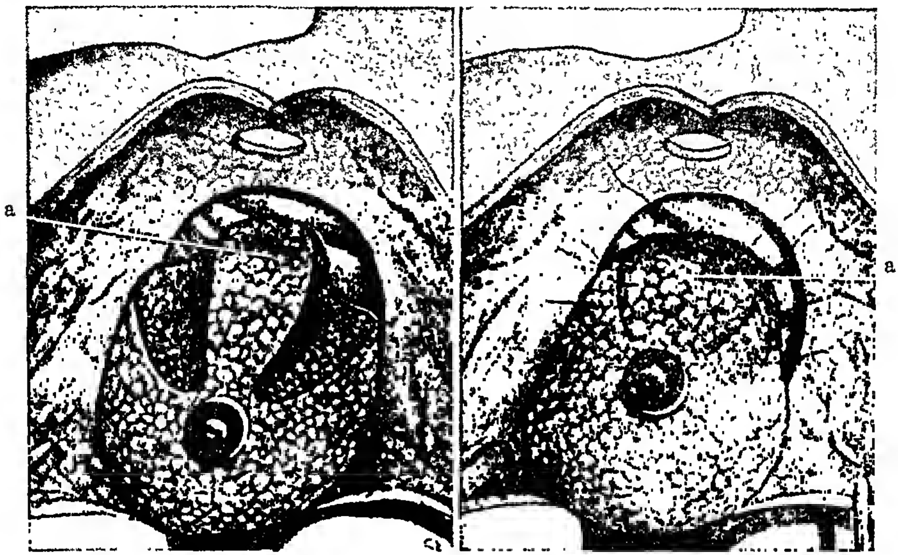
[illegible] of the main arteries are di- [illegible]

Safety of mammaplastic procedures in any type of vascularization thus requires the *confining of glandular excision to the lower quadrants.*

Kaufman's communication (fig. 5) on the vascular pedicles of the breast laid the foundation for the Biesenberger procedure, in which the external half of the breast was resected on the assumption that the thoracic lateral artery did not participate in the vascularization of the gland and nipple and could there-

fore be sacrificed without danger of necrosis. However when Kaufman's report was presented before the Anatomical Society of Paris in 1933, it was severely criticized by Rouviere[2] (21), who on the basis of the recognized distribution of the lymphatics in this region, held that the thoracic lateral artery participates largely in the blood supply of the mammary gland and nipple (fig. 6).

It has since been established that a balance is usually maintained between the two main internal and external vascular pedicles (22) (fig. 7). In approximately 55 per cent of cases the thoracic lateral artery has an equal part with



A B

FIG. 10

Unsound mammaplastic procedure based on glandular excisions from areas corresponding to main vascular pedicles (25).

Wedge-shaped glandular removal is done in the first stage from the upper quadrants in areas corresponding to the main vascular pedicles (see Fig. 7). The remaining central upper pole (a), and the nipple, are thus deprived to a great extent of the main sources of vascularization. Necrosis of the nipple could be avoided under these circumstances only through the presence of a favorable compensatory periarcolar plexus; the latter however can not be foreseen.

A.—Glandular wedge-shaped resection in the upper quadrants corresponding to the vascular pedicles.

B.—Closure of the glandular defects.

the internal mammary, and in 13 per cent, a predominant part in vascularization of the gland and nipple (23) (fig. 8). Since it is impossible to forsee the type of vascularization in each individual case, the surgical method of choice is one which *preserves the blood supply in all types of vascular distribution* (fig. 9). In large hypertrophies this can be done only by the two-stage procedure which, properly performed, assures safety and an esthetic end result. Study of the blood supply of the breast in relationship to mammaplasty during the last fifteen years by Marcus (24), Salmon (23), Maliniac (22) and others, shows that ade-

[2] Professor of Anatomy, University of Paris, France.

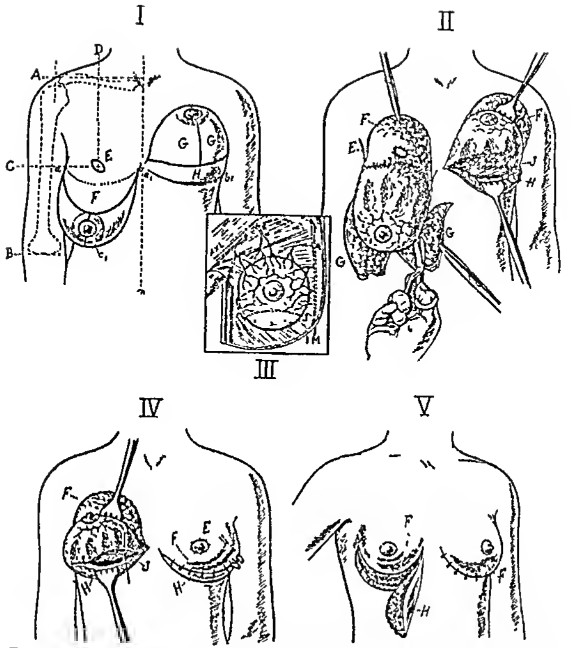


FIG. 11. AUTHOR'S METHOD I FOR THE TWO-STAGE REPAIR OF HYPERTROPHIED BREASTS BY A HORIZONTAL FLAP

I. [illegible] drawn [illegible] ertical [illegible] at E, [illegible]

h—h[1]) to be preserved at first stage.

II.—[illegible]

horizontal flap lined by subcutaneous fat.

III.—Shows *early concept* of the blood supply in the breast. The thoracic lateral (T. L.) and external ma[illegible] ing branches to the exte[illegible] forating branches pene[illegible] through the second inter[illegible]

IV.—Right breast sl[illegible] pectoral fascia. Left b[illegible] H and F loosely approximated and drains in place.

V. [illegible] shaped excision of excessive skin, fat and [illegible] s particularly in [illegible] of impairing the [illegible] defect.

quate vascularization of the glandular pedicles will always prevent untoward complications; the transposition of the central part of the gland can safely be accomplished if the frequent vascular abnormalities of the breast are kept in mind. In the glandular resections illustrated in Fig. 10 the excision of the wedges correspond to the location of the two main vascular pedicles, thus increasing the possibility of necrosis (25). When undesirable results follow a two-stage procedure for central transposition of the gland, the fault usually lies in the execution and not in the procedure itself.

Following clinical investigation of 142 patients operated upon by a two-stage procedure described by me in 1934 (26) (fig. 11), Ragnell (9) states, "Apart from a single case of an exceptionally troublesome nature in which the patient unfortunately developed necrosis of the nipple on one side, there has been no sign of

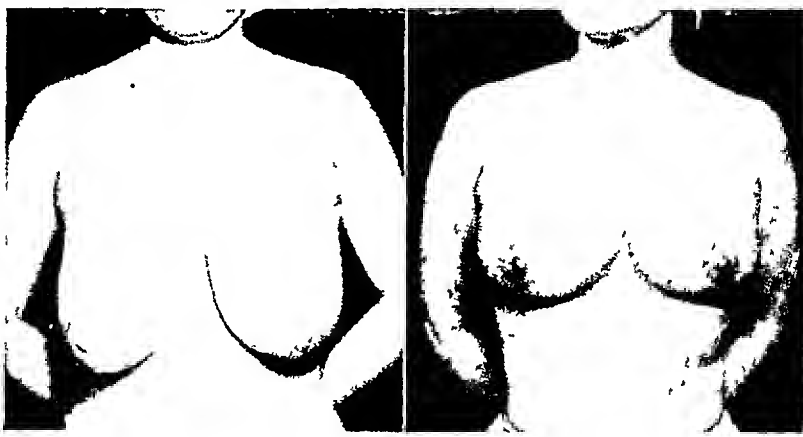


FIG. 12

Excessive width of breast resulting from the use of a single horizontal flap in Author's Method I.

A.—Medium-sized hypertrophy with ptosis, repaired by a two-stage procedure as shown in fig. 11.

B.—Note excessive width of the breast which at present is reduced by midline excision as in Method II (see fig. 14) (26).

necrosis or even cyanosis of the nipples". In 1945, I reported 193 cases of large hypertrophies in which the two-stage procedure was carried out, with absence of total necrosis of the nipple (27). Other observers (28) have also commented on the favorable physiological and esthetic results obtained by this method (figs. 12, 13).

Horizontal versus Double Skin Flaps

A disadvantage in the use of a single horizontal flap in my Method I was the resulting excessive width of the breast (fig. 13). To remedy this, a wedge-shaped glandular excision from the lower quandrants was done regularly in the second stage simultaneously with removal of excess skin through a vertical incision extending from nipple to submammary fold (Method II) (27). The double skin

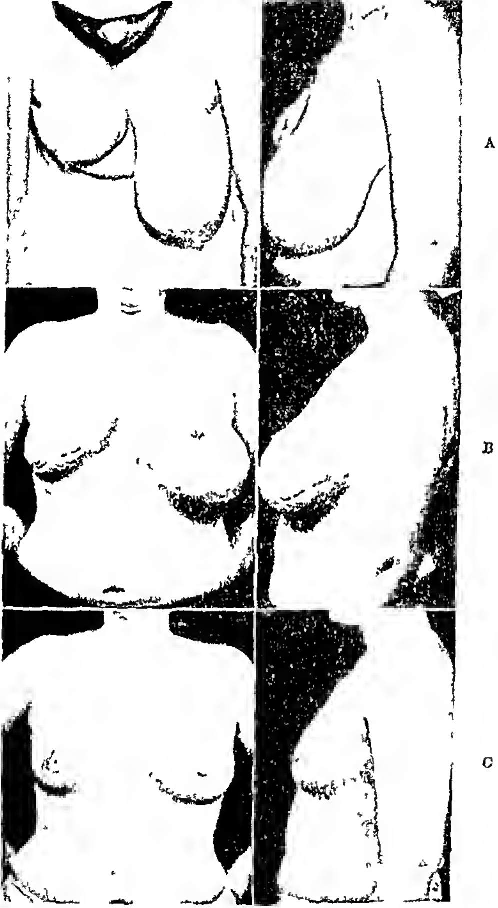
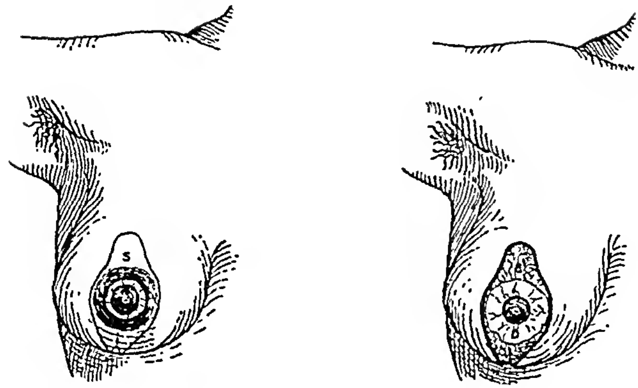


Fig 13

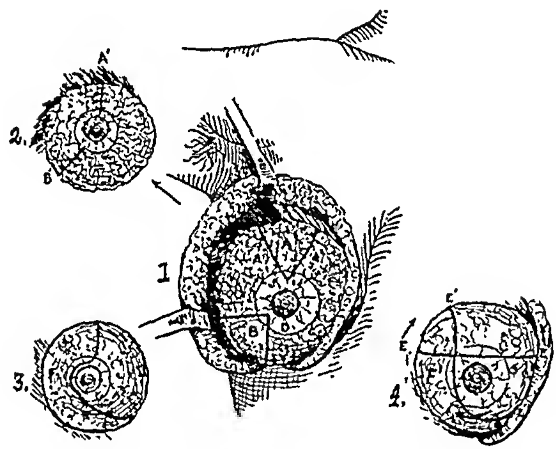
A —(U ... [illegible]
mapl [illegible]
simil [illegible]
trans [illegible]
the central part of the breast

B —(Center) Condition of left breast 6 weeks after first stage of reconstruction (see fig 11)

C —(Lower) Condition following second stage of repair with glandular excision from the lower quadrants, main incision in the submammary fold Nipple and areola tattooed on right breast



I



II

Fig. 14

One or two-stage mammaplasty for ptosis or hypertrophy (method II).

I.—Midline skin excision (S) for open transposition of the reduced areola-nipple zone (N). S^1, central skin defect; lateral flaps are bluntly undermined to expose the gland to the 2nd intercostal space. D, dermal peri-areolar zone following superficial dissection of epithelium, preserving the peri-areolar vascular plexus.

II.—*Safe* and *harmful* glandular resections.

1.—A, B, *safe* areas for wedge-shaped resection in the upper and lower lateral quadrants avoiding injury to the main vascular pedicles of the thoracic lateral and internal mammary arteries. a, a^1, *unsafe* resections in the areas of the main vascular pedicles.

2.—A^1, B^1, closure of glandular defects in safe areas and mastopexy to the pectoral fascia. (Affixation of the gland is done at present along the posterior aspect of the breast).

3.—F, external resection of gland with upward rotation of an internal glandular pedicle; unsafe procedure (Gillies).

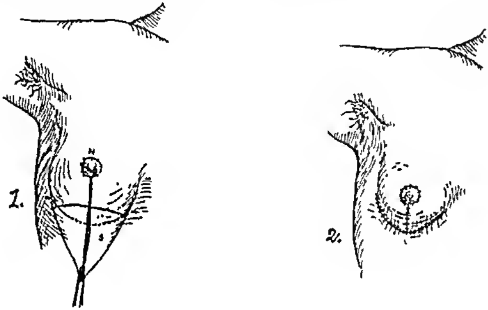
4.—E, E^1, resection of upper half of the gland; F^1, extensive external resection (Biesenberger). These procedures are contraindicated because of the sacrifice of the main blood supply of the gland and possibility of necrosis.

flap is always indicated in ptosis with moderate hypertrophy usually repaired in a single stage (fig. 14). It should however be kept in mind that the blood supply of these flaps is reduced by the midline incision. When they are made thin

and sutured under tension, superficial sloughing of the skin along the edges is liable to occur. The flaps therefore must be of fair thickness and provide an evenly distributed covering for the reconstructed gland; under no circumstances should the skin be submitted to excessive tension (fig. 15).

Preservation of Lactation

Preservation of lactation is always possible in transposition in contrast with the after effects of amputation, provided that the wedge-shaped resection, when required, is carried out distally from the center. Peripheral removal of fatty structures, particularly in the lower quadrants, does not cause injury to the gland; the great majority of fatty breast hypertrophies show masses of fatty



III
Fig. 14
III.—1.—nipple sutured in the upper pole of skin defect; S, lateral flaps are shaped along the midline and submammary fold, m m.
2.—final reversed T-shaped suture line.

tissue localized predominantly in the external lower quadrant without much enlargement of the gland itself.

Normal nipple sensitivity recurs postoperatively in about 80 per cent of the patients *operated upon by the methods of transposition* with wedge-shaped resection away from the center; the gradual return to normal requires three to six months. In the 20 per cent of patients with diminished sensitivity, the degree of reduction varies with the amount of glandular excision.

SUMMARY

1. Total and subtotal mammectomy with resection and free transplantation of the nipple is injurious and esthetically an unsatisfactory procedure.

2. Resection and free grafting of the nipple entail its final severance from the milk ducts so that their continuity can not be re-established. Even with a complete "take" of the graft, this amounts to bilateral necrosis.

A A

B B

Fig. 15

One stage mammaplasty by open transposition for ptosis in girl aged twenty (A)
B —Repair consisted in mastopexy of posterior surface of breast to pectoral fascia (S in Fig 5) Two lateral flaps were sutured in midline and along submammary fold leaving a reversed T scar (25).

3. The nipple and galactophorous ducts can be preserved along with the function of the breast only in mammaplasties based on procedures of transposition

4. In extreme enlargement of the breasts with stasis involving the nipple, mammectomy is indicated.

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MYOSITIS OSSIFICANS OF THE MASSETER MUSCLE

A Case Report

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Myositis ossificans of the masseter muscle is rare. Only three cases were reported since 1924. These occurred in young males as a result of direct trauma to the masseter muscles. One was caused by a bullet; one by a small shell fragment; and one by striking the side of the face on a cart handle.

Ossification of the muscle in each case was confined by the enveloping paretideo-masseteric fascia, extending from the zygomatic compound to the lateral aspect of the angle of the mandible, resulting in severe trismus and some swelling of the involved side of the face.

The method of production of the ossification is believed to be a formation of hematoma which is limited by the tough fascia, with subsequent calcification originating in the region of the traumatized malar bone.

Ivy and Eby excised the entire ossified masseter muscle and used a special trismus apparatus post operatively to maintain the opening of the jaws. Cameron and Stetzer report a case which required three operations with recurrence of calcification and trismus. Final outcome was not reported because the patient failed to return for observation. Nizel and Prigge treated a case conservatively by forceful opening of the jaws with specially constructed appliances. The last authors expect a "gradual diminution of the bony mass over a number of years".

A case of myositis ossificans is presented with modification of the surgical technique.

L. G., a white male, 21 years of age, was admitted for treatment of trismus, 6 months after injury. He was struck by an enemy bullet which entered the right side of face in the region of the malar bone and made its exit at the middle of the anterior border of the right sternocleido-mastoid muscle. Immediately after injury, he noticed numbness in the right side of face and was unable to open his jaw. He was given treatment consisting of physiotherapy exercises, heat and various types of apparatus to force open the jaws. Such attempts were productive of pain, but had no beneficial effect in decreasing the trismus. Physsical examination revealed a normal healthy soldier complaining of inability to open his jaws. All routine laboratory examinations of blood and urine gave values within normal limits. X-ray examination of the involved area was augmented by a laminographic study. This revealed a calcified mass, 4 cms. long and 2.2 cms. wide, extending from the zygomatic bone to the angle of the mandible.

The diagnosis of myositis ossificans was made and the patient was operated on under general anesthesia. The entire mass was excised from the zygomatic bone through a horizontal incision made in the site of the original injury. It was detached from its lower attachment through a submandibular incision.

Post operatively, the patient was able to open his mouth somewhat, but this was asso-

Fig 1 Pre operative Laminograph
A, arrow points to the ossified mass extending from the zygomatic bone to the angle of the mandible

Fig 2 Post operative Laminograph
A, arrow points to the space previously occupied by the ossified mass

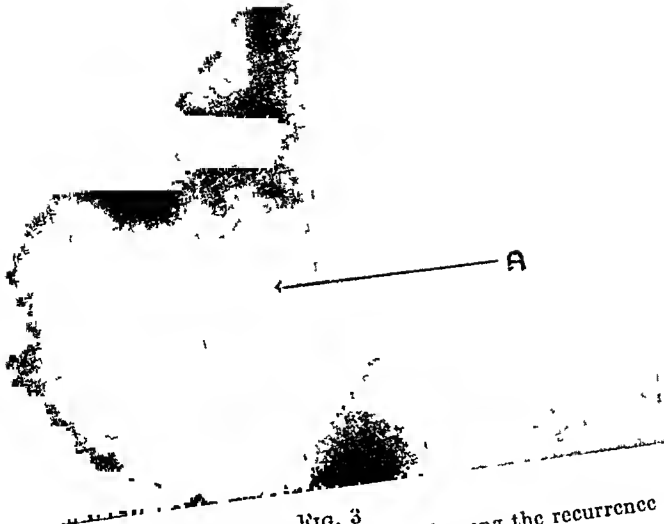

FIG. 3

Laminograph one month after the first operation, showing the recurrence of the mass. Trismus was again present. A, arrow points to the bony mass

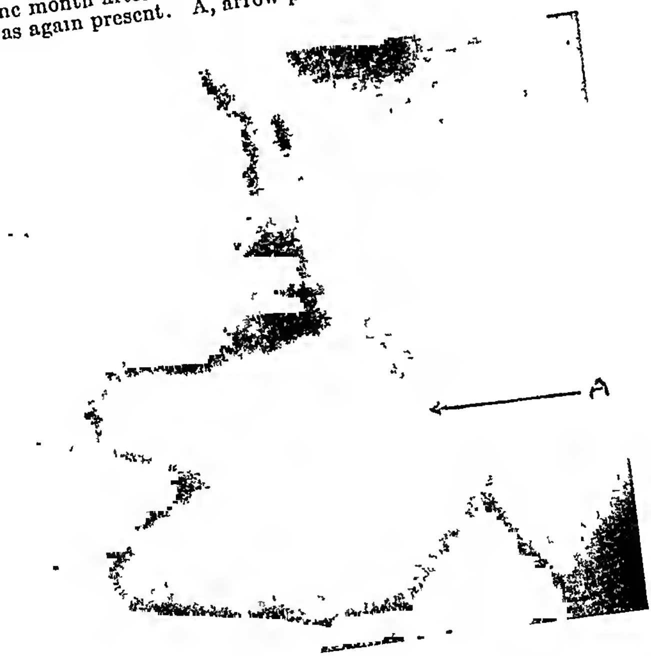

FIG. 4

Laminographic study six months after the second operation There is no evidence of recurrence. A, arrow points to the space previously occupied by the recurrent ossified mass.

ciated with pain In spite of active and passive motion, trismus reappeared One month later, x rays were made and revealed the presence of a similar calcified body although lesser in density This rapid recurrence is believed to have occurred as a result of the formation of hematoma in the space previously occupied by the bony growth and consequent calcification It became apparent that obliteration of the cavity must be accomplished in order to prevent repetition of the ossification Four months after the first operation, the bony growth was again removed This was found similar in size and outline to the first but softer in consistency The cavity so produced could not be obliterated satisfactorily by suturing *A dermal graft was obtained from abdomen measuring 6 x 3 cms* This was rolled compactly and introduced into the space previously occupied by the bony mass The incisions were then sutured in layers

The post operative course was uncomplicated In three weeks, the patient was able to open his mouth fully He was discharged from the hospital three months after the last operation Nine months after the operation, the function of his jaws was unimpaired and he is able to masticate all types of food

SUMMARY AND CONCLUSION

1 Myositis ossificans of the masseter muscle is rare Only three cases were reported since 1924

2 There is a remarkable tendency for recurrence of calcification when the bony mass is removed This is probably due to the fact that the space produced by removal of the bone cannot be easily obliterated

3 A case of myositis ossificans is presented which was successfully treated by filling the space with a dermal graft

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SPONTANEOUS GANGRENE OF THE SCROTUM

Fournier's Gangrene

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The occurrence of complete and apparently ideopathic gangrene of the scrotum in an otherwise healthy male is an unusual condition and of sufficient interest to warrant a report of the following case:

CASE REPORT

A man 44 years of age was admitted to the Toronto Western Hospital in an acutely ill condition.

He had been well until January 17th, 1947, at which time he was painting in a warm place and was sweating, then went from there to unload a car in cold storage. He developed severe chills with accompanying fever. Next day he was very ill with repeated rigors and was admitted to Hospital with a diagnosis of pneumonia. He was given intensive Penicillin Therapy. At this time, he was irrational and appeared extremely toxic and likely to die. On January 18th, 1947, his scrotum became grossly swollen, red, extremely painful and during the following three days, the skin became black and gangrenous, and the lower two thirds, being necrotic, was excised at operation.

His toxaemia decreased during the next ten days and he became rational on the 22nd of January; six days later he developed pain and tenderness in the calf and thigh of his left leg, accompanied by moderate swelling of the soft tissues in these areas. Later the same day, he had a sharp pain in the right side of his chest lasting 24 hours, and accompanied by a mild non-productive cough, and on the next day he developed urinary retention for which he was catheterized repeatedly.

His condition did not improve and he was admitted to the Toronto Western Hospital on February 7th, 1947. On examination, the patient was acutely ill and mental response to questioning was slow and unreliable. On examination, the dependent two-thirds of the scrotal skin was absent and the testicles covered with scant, dirty granulations, were exposed (fig. 1). The penis was moderately edematous, but with no evidence of cellulitis. Enlarged inguinal glands were present. Examination of chest revealed presence of pneumonia of the right lower lobe with associated pleurisy. The left leg showed moderate swelling of calf and thigh, an increase in diameter of ½″ and ¾″ respectively, as compared to the right leg. There was tenderness in pressure and pain on movement in this extremity. The bladder was palpable at the level of the umbilicus and there was urinary retention with overflow. Urine culture, three days after admission showed B Pyocaenus. W. B. C. 11,200 cells per cu. millimetre. Haemoglobin 17.2 gm. (normal 15.4 gm.) R.B.C. 3–7. Colour Index—1.0. Sed. Rate (Westergren) 90 mm. in one hour. X-Ray film of the chest revealed a small area of pneumonia within the periphery of the right lower lobe, associated with a recent pleurisy.

Admission Diagnosis was: Spontaneous Gangrene of the Scrotum with associated deep thrombophlebitis of left leg and infarction of the lower lobe of the right lung. Urinary retention with resultant bladder paresis.

Treatment: On admission, dressings to the scrotum of tulle gras over which half strength Eusol in gauze was placed and renewed twice daily, and scrotal support. Chemotherapy consisted of Penicillin 14,000 q3h, and adequate doses of Sulphadiazine by mouth. Dicoumeral 200 mgm. on admission and 100 mgm. daily controlled by daily Prothrombin estimations. Full diet with fluids to 3,000 cc. per day. Lumbar puncture done on February

FIG 1

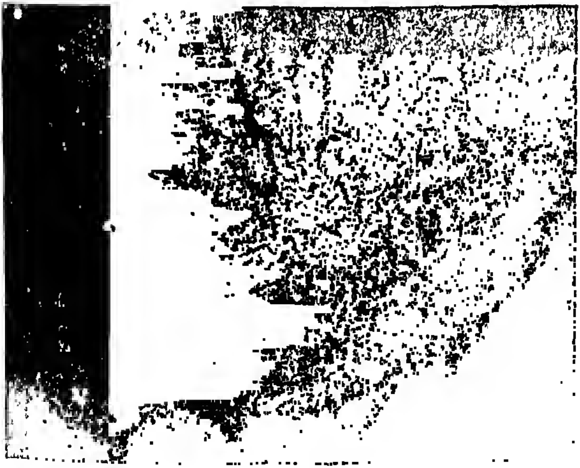

FIG. 2

16th, 1947 was negative for syphilis. A retention catheter with tidal irrigation was inserted on February 8th, 1947, and left in place until cystometrogram readings showed sufficient return of bladder tone to allow removal.

Progress: Under the above therapeutic regime, the patient's general improvement was rapid. His temperature, which on admission was 101½° F. settled rapidly and he was practically afebrile after a week. The denuded area of the scrotum was completely covered with clear granulations by the fourteenth day after admission (fig. 2). Healing was rapid and at the time of discharge, there was only a small area 1 x 1 cm. which was not covered with skin, this was seven weeks after commencement of his illness. The toxaemia rapidly subsided and three days after admission, the patient was bright and well orientated. Physical findings in the lung cleared within sixteen days. The Thrombophlebitis had resolved except for slight residual swelling on the twelfth day. The bladder tone under tidal irrigation and drainage had returned sufficiently to allow removal of catheter on the fourteenth day, and on the twenty-eighth day, the patient was discharged in good condition.

DISCUSSION

Spontaneous gangrene of the scrotum was first reported by Fournier in 1884, at which time he described the three salient features of the condition. These were:

(1) Sudden onset in an otherwise healthy male.

(2) Rapid progression of the gangrene.

(3) Total absence of the normal causes of gangrene.

Since that time, there have been cases reported in the literature which have more or less conformed to this above criteria. There are, however, in the majority of cases, certain other common factors:

(1) Extensive and relatively constant area of gangrene. The testes, spermatic cords and inguinal regions are rarely affected. Involvement of the penis especially in the region of the scrotal-penile fold is not uncommon.

(2) A tendency for spontaneous repair to occur. This is reported by nearly all of the writers. Manson (1) believes that in most cases, there are three triangular flaps of skin left at the margins of, and projecting into the area of slough. Two of these flaps, as he has described are based laterally and one posteriorly. Between them lie both of the testes. These flaps serve as centres from which epithelization begins. In fact, repair appears rather due to contraction of new scar tissue which draws the remaining scrotum over the testes, than to epithelium growing over the granulations from the periphery, thus healing of the wound results in a smaller scrotum.

Aetiology

Aetiology is as yet obscure but at present two theories have been put forward. These are:

A fulminating erysipelas, which is the cause favoured by French authors. This theory does not account for the reason why the severe form of the disease should occur in this area, neither does it consider those cases in which the infection is not due to haemolytic streptococci. Furthermore, it does not occur as a secondary condition in conjunction with other forms of erysipelas, but arises spontaneously in otherwise normal males.

The other theory as proposed by Gibson (2) considers that the disease is a gas gangrene due either to B Welchi or other anaerobes. To support this theory

he states that, "the rapidity with which the gangrene develops and the profound toxaemia which accompanies have no parallel in gangrenous processes of known cause, with one exception, and that is gas gangrene," and also, that "streptococci usually occur in symbiosis with gas-producing anaerobes, and in fact, may obscure the true nature of the condition by their overwhelming numbers."

Manson disagrees with the gas gangrene theory and states that he is unable to accept the first statement; it must be generally accepted the the form of gangrene most rapid in its onset and development is one in which vascular occlusion has suddenly developed. The second statement he accepts but cannot consider it a point of great value in determining the aetiology. Neither of these explains how the infection arises, nor why adjoining areas such as the anal, inguinal, and testicular regions should survive. Gibson's statements do not account for the three flaps which Manson believes to be present in most cases.

Manson offers an alternative explanation, "that the condition is a vascular disaster of infective origin, annlagous to cavernous sinus thrombosis. The infection is not believed to have any specificity other that the existence of a pathogenic organism which causes rapid thrombosis in the area supplied by these vessels." He explains the relatively constant area of slough, on the arterial supply to this area, and accounts for the presence of the three flaps, because "These are supplied by the external branch of the femoral artery and the superficial perineal arteries." The limitation of slough on the under surface of the penis is due to the fact, that "the dorsal vessels remain intact, having no connection with the veins of the mediastinum below the urogenital diaphragm." It seems likely that both authors are right in a degree. The high mortality recorded and the profound illness of this patient certainly evidence more than localized gangrene of the scrotum from vascular occlusion.

Surgical Treatment

(1) Complete castration (Allen (3)). This is unnecessary in view of the rapid spontaneous covering of the area of slough.

(2) Later forms of treatment such as multiple incisions until slough has become separated, combined with the use of zinc peroxide and B Welchi antitoxin have been discarded.

(3) Treatment by radical removal of the necrotic area provides free drainage and speeds up recovery. Surgical repair by skin graft is considered unnecessary.

Mortality

In the cases published, the mortality rate varies from 22% (Whiting (4)) to 31% (Randall (5)).

Death in most cases was due to generalized toxaemia.

Metastatic phenomena such as occurred in this case, are relatively infrequent.

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TWO CASE REPORTS

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The cases presented herein are of interest. The first is that of an old burn of the face and head with marked loss of hair of a young woman dating from childhood. It includes many procedures to gain a cosmetic result with repeated excisions of scar tissue, transposition of flaps, split skin grafting and the use of a whole thickness graft to replace scarred, residual skin. The second is a Marjolin ulcer of the knee following an old burn during childhood, which had been grafted twice and which had degenerated into an epidermoid type malignancy. This condition was aptly described by Marjolin in 1828 as a pathologic degeneration of the skin following old burns and for years the entity was named after him. The ulcerations in this condition, follow a breaking down of old cicatricial skin, remain as a simple chronic ulcer for a long time before low grade malignant change occurs. This usually commences at the ulcer edge and progresses slowly. Sometimes only an area here and there is malignant and the rest shows chronic ulcer changes. The margin becomes red, indurated, and inflammatory while the center is covered with thick proliferative granulation tissue which bleeds readily and gives off malodorous purulent discharge. It frequently is attended with considerable pain of a burning nature. The malignancy metastasizes late due to its low type of malignancy. This case shows the result that can be obtained by wide and radical excision of all the malignant tissue and split skin grafting and is all the more interesting because amputation had been considered by the family physician who felt that this might be the method of choice.

CASE NO. 1

L. C. 18 F. D. Student St. Marks Hospital, Case No. 213053, Admitted July 13, 1943.

Chief Complaint

Loss of hair on the right side of the head and burn scars on the right forehead, face, and neck.

Previous History

At the age of three she suffered third degree burns of the right side of the head, face, neck and forehead as well as back of the right ear. While playing beside the kitchen stove, her mother accidently tipped a kettle of hot grease on her. Second and third degree burns resulted in the areas described. The doctor pinch grafted her forehead and a few scalp areas and she was under Medical attention for three months before healing was complete.

Phys. Exam.

An attractive young girl, brunette, very self-conscious of her disability, with complete loss of hair on the right side of her skull. A marked scar of the right face extends from the front of the ear onto the temporal region and down to the neck below the angle of the jaw. The mesial limit reaches almost to the posterior limit of the malar bone and halfway between the ear and the angle of the mouth. The right forehead shows a large pigmented

riangular shaped scar with many pinch grafts extending slightly beyond the midline (fig. 1).

July 9, 1943. Local anesthesia, novacaine 2% with adrenalin. Reverse fish hook incision in front and behind the ear similar to a meloplasty with marked undermining of the skin to the external canthus of the right eye, the right ala of the nose and the angle of the mouth and excision of two and one-half centimeters of scarred skin from the face, temporal region, front of ear, and neck below the ear. Subcutaneous tissue united by interrupted three-o chromic sutures and the skin by four-o and five-o interrupted silk sutures interspersed with mattress sutures. All skin sutures removed from the fourth to the seventh day and replaced with gauze collodion strips to maintain suture line apposition. Discharged July 11, 1943 for office follow-up

FIG. 1

Burn scar of the right side of head and face with loss of hair, scar extending below the ear onto neck, [illegible] burn during childhood. Pinch grafts [illegible] Marked area of right frontal and tem- [illegible]

December 13, 1943. Same operative procedure in same areas with excision of two and one-half centimeters of scarred skin

July 19, 1944. Excision of wide scar in front and behind ear resulting from two previous meloplasty incisions with additional excision of one and one half centimeters of old scarred skin from face and neck completing removal of old burn scar. Z-plasty was then done on the right side of th [illegible] fifteen centimeters [illegible] temporo-parietal re[illegible] width and length, with the base in the frontal region extending posteriorly above the ear to the occipital region. Both flaps completely lifted and resutured for twenty-one days to insure circulation. Patient allowed to go home between stages with office follow-up. At the end of this time transposition was attempted but due to a large bald spot resulting from the transposed scarred flap, this flap was excised at the frontal hair line region and discarded. An additional pedicle of hair bearing scalp was swung laterally and downward

in the parietal frontal region to diminish the frontal hair line leaving two triangular areas, one large and one small, which were covered with medium thickness split skin grafts from the thigh. The skin grafts were sutured into position and sponge pressure applied over sulfathiazole 5% grease gauze. Hair bearing grafts were sutured into position above ear and in parietal region by No. 4-o silk sutures. Moist boric acid dressings were placed and loose bandages applied to head.

August 18, 1944. All sutures removed, complete take of skin grafts resulted and both hair bearing grafts had firmly imbedded themselves with no loss of pedicle. Discharged for office follow-up. In the period preceding following stage, she was instructed to massage scalp twice daily for ten to fifteen minutes to loosen scalp as much as possible (fig. 2).

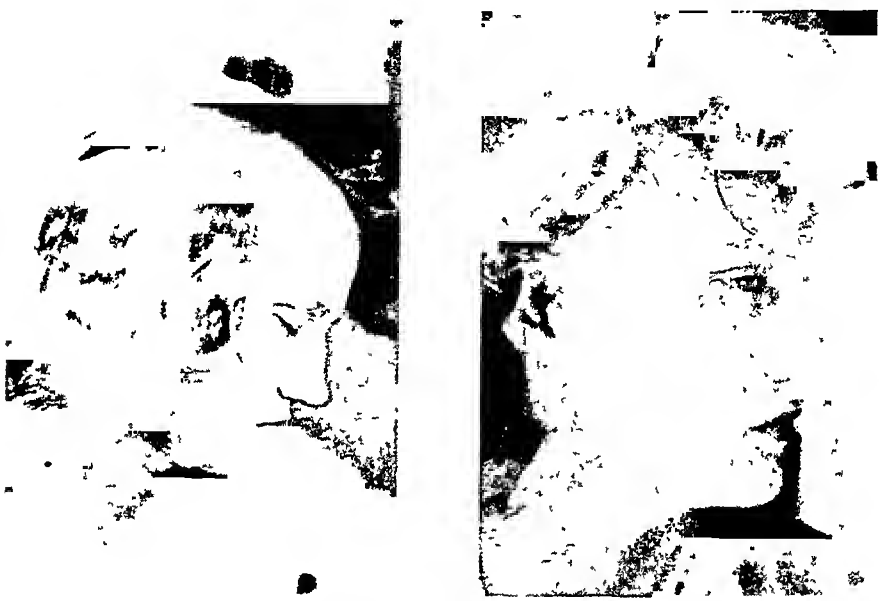

FIG. 2 (left)

Following transplantation of hair-bearing flap to right temporal region from the parietal and occipital region areas above with split skin graft applied to raw area. Note narrowing of bald area due to lateral swing of small anterior flap from upper parietal region.

FIG. 3 (right)

Final result following repeated excisions of scar tissue from face and neck and temporal region by right. unilateral, meloplasty incision of the reverse fish hook type Complete excision of pigmented scar of the right frontal region and replacement by whole thickness graft from the medial aspect of left arm.

June 25, 1946. Under sodium pentothal and gas anesthesia, two-thirds of the large skin graft on the skull approximately six centimeters wide and fifteen centimeters long occupying the upper right temporal and parietal regions extending back to the occipital area was excised. Scalp areas on either side undercut and mobilized toward each other and sutured to remainder of skin grafted area by interrupted sutures of silk, reinforced by two tension sutures of silk worm on buttons to maintain close approximation of hairy scalp on either side of the graft.

July 2, 1946. Sutures removed with complete healing. Former larger grafted area reduced to one-third of its former size.

August 9, 1946. Under sodium pentothal and gas anesthesia the remaining old scar of

the right forehead darkly pigmented and showing numerous light colored pinch grafts completely excised and replaced by inner arm whole thickness skin graft cut to pattern and sutured into position Sea sponge pressure used over sulfathiazole 5% grease strips Donor site closed by undercutting and approximating skin edges by interrupted No 4 o silk sutures

August 21, 1946 Complete take of whole skin graft Sutures removed (fig 3)

Since this young lady's discharge from the office follow up on September 1, 1946 when all sutures were removed, I received a letter from her father late in December stating that the cosmetic effect of all the operative procedure has been satisfactory and "that she has undergone a beneficial personality change and is engaged to be married preceding her graduation from college in 1947"

CASE NO 2

H B M S Student 22 St Marks Hospital, Case No 21602, Admitted April 6, 1944

Chief Complaint

Ulcerating, bleeding, foul smelling growth of the right knee region

Present History

Seventeen years ago at the age of five, he was badly burnt on both legs while playing around a bonfire After protracted hospitalization including skin grafting of both legs especially the left one above, over and below the knee, he recovered One area on the knee healed but kept breaking open Five years later this area was regrafted but would frequently crack open, ulcerate and then heal Seven years ago a peculiar growth started on the knee This would enlarge and then get smaller but there was a gradual tendency to enlargment He was able to get around even though the knee was painful and flexion limited Four months before admission the ulcerated area commenced enlarging rapidly, bleeding freely and the discharge became foul smelling He was unable to bend the knee and walked stiff legged One physician advised possible amputation, another insisted on his entering the hospital for examination and treatment

Physical Examination

Examination of the extremities shows the following right leg markedly scarred by old burns from above the ankle halfway below the knee showing evidence of old skin grafts, some pinch grafts Left leg markedly scarred from old burn above ankle to ten centimeters above knee Large fungating, foul smelling cauliflower growth of the knee and surrounding tissue, the size of a large grapefruit and occupying the entire front of the knee and extending laterally on each side to almost the internal and external hamstring group of muscles Tumor bleeds freely and the edges are curled and eroded Marked area of induration surrounding the periphery of the ulceration Knee kept in extended position due to pain on the slightest flexion (fig 4)

Provisional diagnosis

1 Basal cell carcinoma
2 Infectious granuloma of knee
3 Fungus infection of knee

Lab Exam Blood and urine findings within normal range Kahn test negative

April 7, 1944 X ray shows normal knee joint, no bony involvement but some decalcification of the tibia and the femur Biopsy done under sodium pentothal anesthesia, and many sections of tissue removed from the center as well as various locations of the ulcer margin showed all to be epidermoid squamous cell carcinoma grade one with the bordering skin much inflamed

April 11, 1944 Under sodium pentothal and gas anesthesia, the fungoid carcinoma was completely excised with the electro surgical knife the excision extending two centimeters

beyond the edge of the ulceration and in depth down to the capsule of the knee joint and the tendon of the patella. Laterally the skin and subcutaneous tissue were excised down to the areolar tissue covering the internal and external hamstring muscles. Smaller vessels

FIG. 4

Large fungating, mal-odorous, epidermoid carcinoma, grade one, of the left knee following old third degree burn of many years duration.

FIG. 5

One month after operation the moderately thick, eighteen thousandth of an inch thickness skin graft was completely healed. Elevated appearing areas are due to localized thickening of the graft.

were electro-coagulated, larger vessels ligated with fine silk. Following operation continuous boric acid dressings were applied. Dressings changed daily under gas anesthesia. Blood transfusion, 500 cc given on April 17, 1944 and was repeated on April 31, 1944 to combat anemia. May 2, 1944 to May 6, 1944 the dressing was changed to azochloramide in oil in order to reduce surface infection and stimulate granulation tissue.

May 6, 1944 Due to marked free bleeding of granulation tissue and reduction of discharge continued saline dressings were applied for twenty four hours over fine gauze dressings preceding skin grafting

May 8, 1944 Three dermatome units moderate thickness grafts, 018 inch, were removed from both sides of the back and left buttocks These were sutured into place entirely covering the raw area Sulfathiazole 5% strips with pressure dressings of sea sponges were applied with two catheters inserted deep into the sponges for continuous moist dressing Boric acid solution instilled every four hours Leg kept in extended position by a posterior splint of leg Septic temperature for nine days following operation, maximum elevation being 102 8 Outer dressings of knee changed daily

May 16, 1944 Blood transfusion 500 cc to combat anemia Hemoglobin 75% R B C 3,700 000

May 17, 1944 *Temperature normal for two days*

Sponge dressings removed with complete take of grafts except two areas, one the size of a dime and the other a quarter on the internal and lateral aspects of the knee, probably from insufficient pressure at these points Bettman scarlet red grease strips were applied and on May 23, 1944 he was discharged, able to walk with donor sites on back almost completely healed and knee areas almost epithelialized

Follow-up

This young man seen on June 20, 1945 with a complete healing of the knee, good flexion and extension of the leg No swelling of the leg (fig 5)

December 21, 1946 Communication from him says "feeling fine, no recurrence from ulceration Graduating from college June 1947 and intends entering the Government Ranger Service"

RECONSTRUCTION OF THE LEFT MAXILLA

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Loss of the maxilla and malar bones, following their excision for antral tumours, or from trauma, leaves a characteristic deformity of the face. Many surgeons, over the past thirty years, have directed their attention at the reconstruction of this deformity, particularly to the restoration of the orbital floor and upper face. A prosthesis is used in most cases to close the palate and the defect into the nose.

In 1919, Sir Harold Gillies described the use of a temporal muscle flap to fill out the depression in the upper cheek, and in 1938, Doctor Figi described cases where he had used shaped iliac bone grafts to restore the upper facial depression. To overcome the up-drawing of the mouth angle, Doctor Figi used buccal inlay grafts to replace the loss of the lining mucosa.

The present case is one in which the maxilla and malar had been excised, leaving no defect in the cheek but with the characteristic deformity of the face. Temporal muscle and iliac bone were used in the reconstruction but an attempt was made as well, to surgically close the palate and to reconstruct a bony alveous.

This 25 year old man came under my care in 1946, with a history that his left upper jaw had been excised for a tumour growth in 1936. On investigation, this growth proved to have been a benign osteoma. At the original excision, the left half of the maxilla and antrum had been removed, with it, a portion of the body of the left malar bone and the anterior one-third of the orbital floor. This had been allowed to granulate in and a marked retraction of the left check with up-drawing of the angle of the mouth took place (fig. 1). He had been fitted with a prosthesis, maintained in position by his opposite maxillary teeth.

In 1940, his teeth became abscessed and loose, but were saved for fixation of the prosthesis. During the following five years, he had much pain and toothache and the teeth become very loose, so that he could not wear the prosthesis.

In 1945, he developed multiple large dento-alveolar abscesses and in December, 1945, Doctor E. McNeill bad to extract the right upper maxillary teeth.

In view of his young age, (25), and his strong desire to have the palate defect closed and to wear the usual type of upper denture, the following reconstruction was carried out:

In January, 1946, the first stage operation was performed under endotracheal, nitrous oxide, oxygen and pentothal anaesthesia. Through a "U" shaped left temporal incision, the anterior one-third of the temporal muscle was exposed. This anterior third was detached from its origin to the temporal squama and frontal bone, care being taken to preserve its vascular and nerve supply. This muscle flap was passed down behind the zygomatic arch and remains of the malar, and brought forward into the mouth after detaching the buccal mucosa from its false attachment to the orbital periosteum and remains of the orbital floor. This large muscle flap was swung in to the defect in the mouth and sutured to the freed remains of the buccal mucosa, to the floor of the nose, and to the remains of the frontal process of the maxilla on this side (fig. 2). The temporal wound was closed in layers. Through the mouth, the palate, on the right side, was completely mobilized by a curved incision around the alveolar margin and by dissecting the muco periosteum backward, the neurovascular bundle was exposed. It was necessary to free the neurovascular bundle to the palate flap, on the right side, and to excise sufficient bone around its osteum to allow sufficient excursion of the flap to the left without compressing and shutting off the blood

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FIG 1 PRE OPERATIVE APPEARANCE WITH TYPICAL FACIAL CONCAVITY AND UP DRAWING OF THE LEFT ANGLE OF THE MOUTH

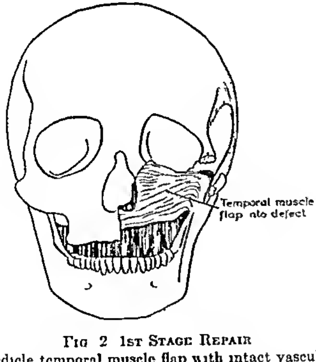

FIG 2 1ST STAGE REPAIR

Transposition of pedicle temporal muscle flap with intact vascular bundles, turned in and sutured into defect in left antral region

supply This large palate flap was tacked to the muscle flap so that no dead space was present The palate flap itself was sutured to the edges of the freed buccal mucosa and was held down to the bony palate by passing two mattress sutures of #35 gauge stainless steel wire The raw area of the bony palate, on the right side, was left to granulate in (fig 3)

This stage was completely successful, closing the palate defect and separating the nasal cavity from the oral. The old antrum defect was filled by the temporal muscle (fig 4).

In March, 1946, the second stage was done. A bone graft was removed from the left ilium, comprising the outer plate from the anterior superior spine to the posterior superior spine. This bone graft was suitably shaped. The cheek was opened through an incision along the lower eyelid, down the side of the nose, beneath the left ala nasi and down the

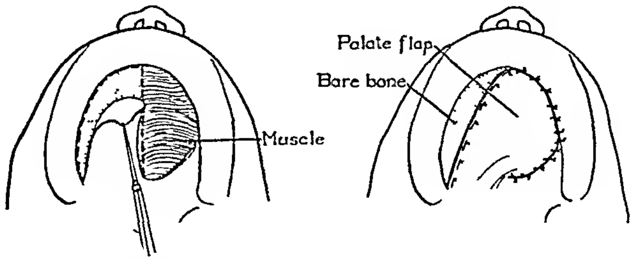

Fig. 3. 2nd Step in 1st Stage Operation for Repair

This palate flap approximated and sutured to temporal muscle flap beneath and fastened to the hard palate with mattress sutures.

Fig. 4

Appearance of patient following first stage operation. Note the fullness in the left cheek from the transposition of the muscle flap.

midline through the philtrum. This flap of skin and fat was turned back and the dissection was carried deep to the facial muscles. This exposed the temporal muscle flap in its antral position. The lip was undermined just superficial to the buccal mucosa; the alveolus on the right side, was exposed; the remaining frontal process of the maxilla and the orbital periosteum were uncovered. The external angular process and the remains of the malar were freed from surrounding muscle and scar.

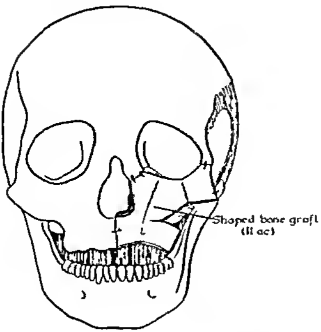

Fig 5 2nd Stage Operation

Shaped iliac bone graft inserted subcutaneously beneath facial muscles on top of the [illegible] set beneath the mucous membrane [illegible] nal angular process, nasal process

Fig 6 Roentgenogram of Skull after 2nd Stage, showing Large Bone Graft in Position

Dissection was carried deeply between the muscle planes into the ptergo mandibular fossa so that the posterior end of the maxillary bone graft could be inserted The shaped iliac bone graft was placed in this prepared bed and in this way, a bony alveolus was constructed The bone graft was wired in position and the facial wound was closed in layers

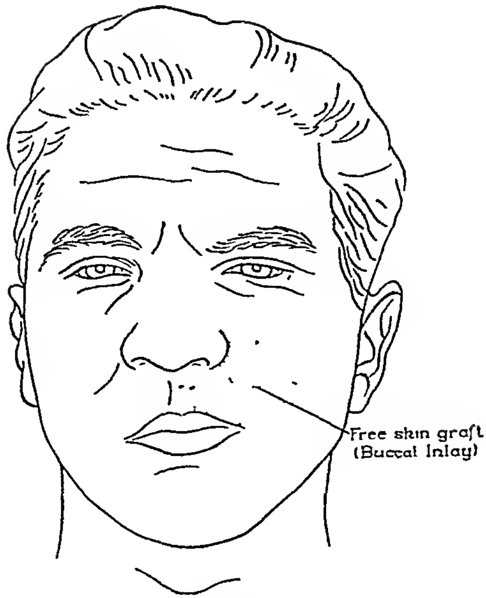

FIG. 7

Drawing to show location of the buccal inlay graft to form the upper alveolus as the 3rd stage operation. Skin graft was used to line the cheek and cover over the surface of the alveolar portion of the bone graft.

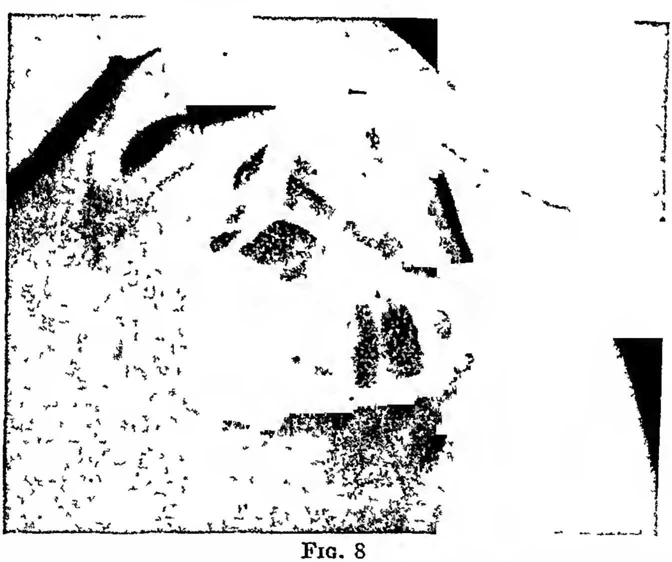

FIG. 8

The newly formed left alveolus is seen, somewhat thicker than normal and covered by the buccal inlay graft. The palate is closed and this alveolus supports well the base plate of his denture.

There was no difficulty encountered in this operation and the bone graft revascularized well. The facial muscle action was not disturbed by the procedure (figs. 5 and 6).

The third stage was done in May 1946 At this time the bone to form the new alveolus was in the substance of the upper lip covered on its inner surface by buccal mucosa An incision was made through the buccal mucosa along the outer border of the new bony al

Fig 9 Final Photographs showing the Amount of Correction of the Facial Deformity and of the Left Upper Lip

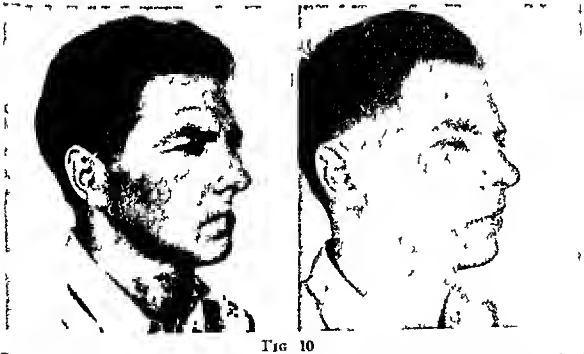

Fig 10

Pre and post operative photographs to show the normal side of the face Note the deformity of the upper lip which has been corrected by the restoration of the alveolus

veolus and the lip and cheek were freed from the bone graft well upwards and backwards, leaving a layer of soft tissue over the bone A large buccal inlay graft of free skin from the abdomen was inserted into this area and a good take was obtained (figs 7 and 8) He was immediately fitted with an upper denture of the usual type which he wore continuously

during the summer. There was some over-correction of the flange on the left side of the denture so that the skin graft remained under some tension.

He was seen in November, 1946, and at this time, the posterior buccal sulcus was not quite deep enough and one thought an additional piece of skin should be added in this region for better fixation of his denture. In view of the thinness of the soft tissues of the cheek, from loss of fat, particularly in the upper portion, it was felt that a dermal graft should be inserted here, to round out the area and give a better cosmetic result. This was done in December, 1946, with overcorrection to allow for later atrophy.

The patient was re-examined again on the 15th of October, 1947, and the new alveolus was found to be standing up well. Doctor Emerson McNeill has constructed for him the usual type of upper denture and it is affording him no discomfort. It stays in well and functions satisfactorily. There has been a little shrinkage of the dermal graft since the last examination but the original overcorrection has allowed sufficiently for this atrophy. The rounding of the face in its upper third remains adequate (figs. 9 and 10).

This patient had some diplopia following his original operation in 1936 but this was fully compensated in the intervening years. This has provided no problem in this operation and he had no diplopia or blurring of vision at the present examination.

The author expresses his appreciation for the excellent services of Doctor Emerson McNeill of the Dental Department and of the Medical Art Department of this hospital for the photography, and to Miss Roberge for the drawings.

CONCLUSIONS

Reconstruction of the left upper jaw has been accomplished, and no more time has been consumed than would be expended in the reconstruction of the upper face only. It has provided this boy with an upper denture which is light, which is easily maintained in position, and the general appearance, one believes, has been much improved. Such procedures might not be wise in one much older, but in view of the youth of this patient, it seems justified. He is no longer troubled with the trapping of food, and the discomfort of an unwieldy prosthe*tic appliance, nor with the escape of air, and a "nasal" sound in his voice.*

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THE USE OF VITALLIUM PLATES TO MAINTAIN FUNCTION FOLLOWING RESECTION OF THE MANDIBLE

BROMLEY S FREEMAN, M D , F A C S *

Resection of the mandible necessitates immediate post operative fixation of fragments to prevent external and internal distortion resulting in respiratory distress, feeding problems and severe deformity In adults with teeth, retention of the proper relationship between fragments, with the later restoration of bone continuity, can be accomplished with intra-oral wires or dental splints In edentulous adults and in children, retention of the fragments is difficult Immediate bone grafting, in our experience, has failed because of either oral contamination or incomplete fixation of the fragments Following resection of a sizable portion of the mandible, without stabilization, the mental anguish and depression incident to the deformity, although great, are secondary to the immediate serious difficulty in respiration, mastication and speech Furthermore, fixation of the remnants of the jaw in malposition makes secondary bone grafting unnecessarily difficult Vitallium plates, fixing both fragments firmly in their original places and maintaining rigidity of the mandible during the period between operations, have been successfully used to prevent these sequelae

Case 1 In April 1944, an edentulous, 42 year old white mess attendant presented himself at the Tumor Clinic, Veterans Administration Hospital, Hines, Illinois, with a recurrent, squamous cell carcinoma of the right lower alveolar ridge, with extension to the buccal mucosa and invasion of the right mandible On July 5, 1944, under pentothal oxygen anesthesia, 7 cm of the horizontal ramus of the right mandible were resected in the course of a wide surgical excision and suprahyoid neck dissection The floor of the mouth and the buccal mucosa were mobilized and sutured by two rows of Halsted inverting silk sutures An ordinary vitallium Sherman plate such as is used by orthopedists was inserted to bridge the hiatus caused by the resection of the jaw The plate was firmly fixed by stainless steel wires drawn through drill holes in the mandibular ends The neck incision was closed without drainage, after irrigation with saline solution and dusting with sulfathiazole This procedure was done solely with the idea of preserving function, allowing the intra oral incision to heal, and at a later date inserting an iliac bone graft Convalescence was uneventful and the patient was discharged with instructions to return However, during the past two and a half years the patient's jaw function has been normal the patient remains in excellent health, and recent X rays show solid fixation of the vitallium bar at the two ends, with no evidence of erosion of the mandible The patient is so well satisfied with the cosmetic and functional result that he has repeatedly refused to come in for a bone graft

Case 2 An edentulous patient, W W H , with post irradiation, recurrent, squamous cell carcinoma of the buccal mucosa extending to the alveolar ridge A resection of the horizontal ramus of the mandible was performed, together with a wide resection of the tissues of the floor of the mouth and right upper neck dissection on November 15 1944, under procaine block, pentothal and oxygen aneathesia After careful closure of a buccal mucosa flap, the mandibular ends were stabilized by a vitallium plate placed across the gap and fastened with stainless steel wires, passed through drill holes in the bone ends The neck

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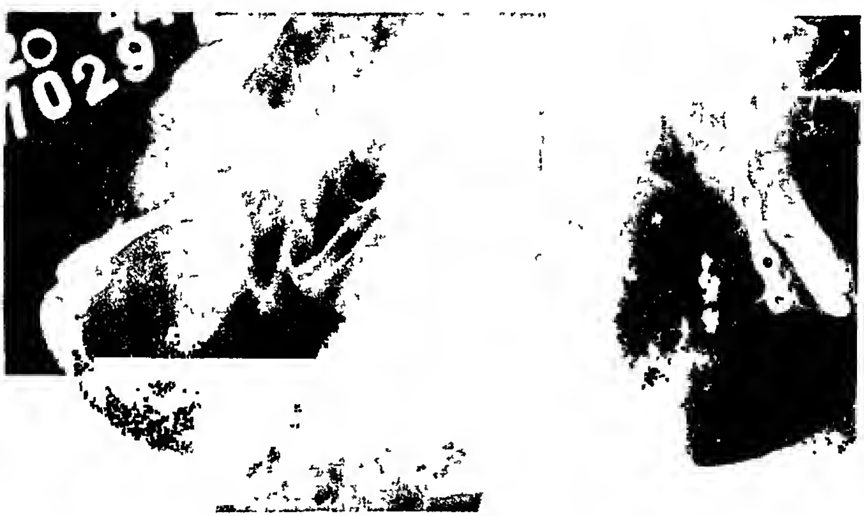
* [illegible] Texas

Su[illegible] or Department of Medicine and [illegible]ibility for the opinions expressed or conclusions drawn by the author

incision was closed in layers without drainage, after dusting with sulfathiazole powder. There was normal jaw function for nine months. However, in the course of a routine follow-up, a deep submucosal recurrence at the posterior end with extension to the retromandibular fossa was found. This necessitated a wid eelectrocoagulation of the entire area and removal of the vitallium bar. At the time of removal the fixation of the lower end was so firm and the bone of the mandible had grown over the ends of the vitallium plate to such a degree that chiselling of the bone was necessary to permit removal of the prosthesis.

Case 3. J. G., a 40-year-old white truck driver, was admitted to the Tumor Clinic in October 1945, for what, clinically, was an adamantinoma of the major portion of the left mandible. The lesion extended well up the ascending ramus and anteriorly almost to the symphysis. In conjunction with our dental department, two types of vitallium splints were made, patterned after the curvature of the mandible. On November 27, 1945, an incision was made down to the periosteum of the mandible, which was found to be attached to the tumor. Dissection was continued to the sigmoid notch, and inferiorly to a point



a b

FIG. 1. CASE 1. X-RAY OF JAW WITH VITALLIUM PLATE IN POSITION
a. Taken on 15th postoperative day. *b.* Taken 2½ years after operation

past the symphysis. Decision to resect was made after frozen section examination revealed a myxosarcoma of the bone. The oral mucosa was sectioned, and the mandible freed on both sides. The internal pterygoid and masseter muscles were freed, and the mandible sectioned one centimeter and a half below the sigmoid notch and one centimeter proximal to the symphysis. The buccal mucosa was closed in layers with fine cotton. The previously prepared vitallium appliance was attached to the end of the ascending ramus, using two vitallium bolts; the anterior portion was attached to the right side of the symphysis, but, as the bolts had been cut too short, it was necessary to use two vitallium screws. The masseter and internal pterygoid muscles were attached to the vitallium appliance, using 35 gauge stainless steel wire. The wound was sutured in layers without drainage. Penicillin was given post-operatively.

Two weeks after operation a swelling of the left jaw was noted, and approximately 10 ccs. of clear fluid were removed by aspiration. Culture showed no growth, and a pressure bandage was applied. This was unfortunate because, during approximately the sixth post-

operative week, the sharp edge of the vitallium prosthesis protruded through the skin Cultures remained negative until January 25 1946, when aerobic study showed a few staphy-

Fig 2 Case 3 Vitallium Prostheses Prepared for use Prior to Operation

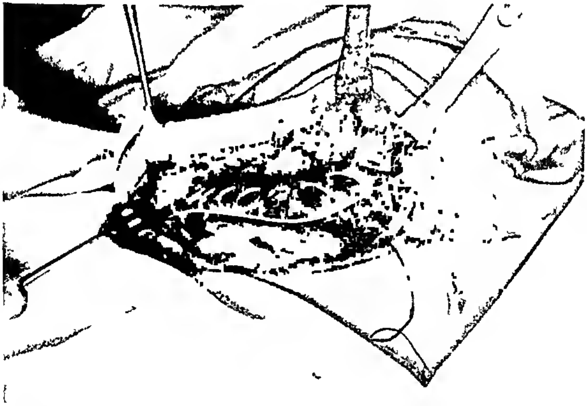


Fig 3 Case 3 Vitallium Prosthesis in Place at Time of Operation

lococci, streptococci and diphtheroids Smears throughout showed no bacteria Again, after pre operative penicillin therapy, a secondary closure of the wound was performed,

with local administration of penicillin. Penicillin was also given post-operatively. The wound healed well and the patient was discharged on March 11, 1946. The patient was re-admitted on April 3, 1946, and stated that soon after his discharge, the skin over the plate became thin and later eroded, following which there was drainage from the site of erosion. Again a secondary closure was performed by another surgeon, inasmuch as I was on duty elsewhere. His report reads: "Granulation tissue was removed, skin margins undercut, and the masseter muscles used to close and cover the angle of the jaw. The wound was sutured with catgut sutures, and a fresh pressure dressing applied". This broke down, and on July 7, 1946, the vitallium plate was removed by the same surgeon, who reported: "The screws in the region of the ramus were so deeply imbedded that considerable force

Fig. 4. Case 3

Patient after removal of vitallium plate, 8 months postoperative and prior to insertion bone graft. Note absence of deformity of jaw because of scar fixation.

l to be exerted before they could be freed. The screw heads were covered by a new wth of bone, and there was no evidence of osteomyelitis or osteoporosis in the ramus the symphysis. Similarly, the bolts in the ramus were loosened with difficulty and the plate removed". Because of the scar fixation, the jaw remained in line and no deformity was encountered by the patient. The wound healed uneventfully, and, in December, 1946, an ilial cancellous bone graft, after the manner of Blocker (2) was easily performed.

On reconsideration of this last case, it would seem that, had a less cumbersome type of replacement been used, such as a simple bar, there would have been no sharp edge to cause erosion of the skin when the pressure dressing was applied.

Simple Sherman type plates of vitallium (7), in varying sizes, can be bent to proper curvature in the operating room. If necessary, a specially curved plate can easily be prepared in any dental laboratory equipped to make vitallium prostheses. The area to be resected is outlined; the metal plate is bent to the approximately desired curvature, using a pair of pliers or the fingers; the positions of the plate holes are marked with drill holes made into the bony part to be left; and, while the mandible is being resected, the plate is resterilized. After the oral cavity has been closed tightly with interrupted non-absorbable sutures, the wound irrigated, and the instruments and gloves changed, the plate is attached by small vitallium screws or bolts. Even in the presence of wound infection metal plates can be allowed to remain in position for a considerable period of

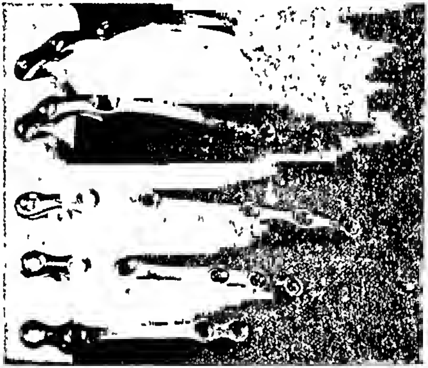


FIG. 5. SHERMAN TYPE VITALLIUM PLATES OF VARIOUS SIZES AND BENT TO VARYING ANGLES

time in order to stabilize the bone fragments and prepare them, if necessary, for a later graft. The use of bars and plates in the mandible has been decried by others (1, 6), but it is felt that the techniques, rather than the appliances, employed were at fault. Winter (8) has advocated using a vitallium prosthesis after a resection of the anterior portion of the right and left mandibles, but he has not reported follow-up observations.

It is possible to make a tantalum plate of the type used by Blocker (2, 5), but the ready availability of the Sherman plate, the simplicity of the procedure, and the lightness, rigidity and strength of vitallium constitute distinct advantages over the use of tantalum. It is felt that the double screw fixation at both ends results in rigidity that cannot be obtained by the intra-oral stainless steel pin used by Brown and Byars (3, 4), which can become loosened in the bone ends, or twist, thus altering the space relationship of the fragments. Furthermore, the pin used by Brown and Byars (3, 4), may protrude through the mucosa.

In summary, vitallium plates have been used for immobilization of the bone ends after resection of the mandible. Such use of vitallium plates is advocated as a simple, dependable method of stabilization in aged or debilitated persons in whom bone grafts are not feasible, and as a temporary measure for those patients who will eventually have bone grafts.

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THE USE OF A COMPOSITE GRAFT IN RECONSTRUCTIVE SURGERY OF THE LOWER EYELID

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The repair of various deformities resulting from accidental or surgical loss of all or part of the lower eyelid has remained one of the most difficult problems of reconstructive surgery (1).

In this article a new application is made of an old technique (2). More recently, Brown and Cannon (3) published an article in which they advocated the use of a composite graft, from the helix or crus of the helix of the ear, in the reconstruction of tissue losses about the ala nasi. We have made use of a composite graft, taken from the crus helicis, (fig. A) in the reconstruction of the lower eyelid and althougb only a few cases have been done using this procedure, it offers a solution to a difficult problem in eyelid surgery. It is usually a one stage procedure, hospitalization is short, and the end results are very satisfactory both from a functional and cosmetic standpoint.

A composite graft from the crus of the helix is a near approach to a morphological restoration. It has a size and shape which corresponds to the lower lid and fits the globe of the eye very well. The cartilage in the composite graft gives support and prevents sagging of the new lid and this factor gives additional insurance for a complete take. Also, it replaces the tarsal plate when missing or inadequate. The grafts do not shrink appreciably, color match is excellent, take is uniformally good if width of the graft is not more than about 1 cm. (3). The defect of the ear is repaired easily, without grafting, at the same stage and the resulting deformity is not objectionable, if noticed (fig. B).

The following technique has been used: Under local anesthesia, using a 30 gauge needle, the conjunctival and skin surfaces of the defect are separated at their juncture and developed by sharp and blunt dissection. If the line of juncture is straight the incision is made about 1.5 mm. on the skin side. This facilitates sewing and healing as skin is sutured to skin rather than to mucous membrane. In addition, any lashes present may be preserved. Should the juncture line be ragged or irregular a horizontal wedge of tissue is removed, as necessary, to straighten the lid margin. A pattern or caliper measurement of the lid defect is made, mapped out on the crus with brilliant green and under local anesthesia the composite graft is cut with a #11 Bard Parker, or stab blade, the blade carrying through all layers of the helix. While an assistant repairs the donor site with interrupted 4-0 silk, the graft is carefully sewed in place along both edges with interrupted 6-0 silk. One arm of the suture, after tying, is left long to tie over a layer of vaseline gauze and a stent of gauze or cotton waste—the bolus type dressing for pressure and immobilization. The eye is then covered with additional cotton or waste which is held in place with elastoplast. Dressings

are changed on the fifth day and sutures are removed on the sixth and seventh days. An eye pad is worn until healing is complete.

The skin on the orbital side of the graft is tailored, or removed, so that the conjunctiva is used to its fullest extent as conjunctiva is best for contact between lid and orbit and it gives a rich blood supply to the composite graft. It will usually be found that sufficient conjunctiva can be mobilized to cover part or all of the orbital side of the graft (4). However, after the graft has taken well, the skin on the orbital side, if a normally functioning eyeball is present, should be replaced with a mucous membrane graft from the lower lip (5).

It is our opinion that this procedure is applicable for repair of surgical or traumatic loss of the upper lid. Also, for the correction of ectropion. In ad-

FIG. A (left). PRE-OPERATIVE PHOTO SHOWING MAP OF COMPOSITE GRAFT ON CRUS OF HELIX

FIG. B (right) POST-OPERATIVE PHOTOGRAPH SHOWING DEFECT REPAIRED

dition, we have found that the cartilage of the composite graft assists in readjusting the position of distorted or out of line palpebral commissures by affording a subcutaneous prop.

Briefly, the history of the cases in which we have used this technique:

Case 1 A 50 year old, white male, who lost his lower left lid in childhood from erysipelas and since has had many operative procedures including the injection of bees-wax into the area, a neck tube, which was lost in transfer and adjacent flap grafts which caused much scarring.

The bees wax was removed together with much scar tissue at the stump of the lid A near full thickness "stent" graft, taken from the clavicular area, was used as a first step and a foundation for the composite graft. Also, at another stage, a dermal graft was used to prevent adhesions to the infraorbital ridge. Finally, the composite graft from the crus of helix was used. There was a complete take and the patient is now free (six months later) of chronic conjunctivitis and does not have tearing. He can now carry on his work without the use of dark glasses, something he has never been able to do before (fig C).

Case 2 A 37 year old, white male, had left lower lid accidently burned with lye about 5 years ago, resulting in chronic ulceration A diagnosis of basal cell carcinoma of lower

FIG C POST OPERATIVE PHOTOGRAPH SHOWING RECONSTRUCTED LID
[Note ear defect and numerous scars on face and posterior auricular area resulting from previous attempts at surgical repair

FIG D

a (Left) First post operative dressing Note sutures are still in place and slight dis

Note ear defect Graft has taken throughout and is is almost perfect

c (Right) Post operative photographs showing that the patient can completely close the eye with normal effort

lid was made on 15 November 1946 and the lid removed surgically Seven months later, 1 July 1947, the lid was reconstructed with a composite graft taken from crus of right helix The take was complete and the end result very satisfactory functionally and cosmetically (fig D a, b, c)

a b

e d e

FIG. E

a. (Upper Left) Pre-operative photograph. Patient is lying on the operating room table. Note the loss of the lower lid.

b. (Upper Right) Post-operative photograph taken at five days. Sutures are still in place.

e. (Lower left) Post-operative photograph taken ten days after surgery, discoloration and swelling in lower lid is rapidly subsiding.

d. (Lower center) Close up photograph showing reconstructed lower lid three weeks post-operatively. Note upward projection of the lower lid and lack of noticeable deformity in the ear.

e. (Lower right) Photograph taken six weeks after surgery. Patient can easily close eye.

Case 3. Mrs. M. D., a white female 38 years of age had a birthmark on lower left lid of "pin head" size. It began getting sore about 12 years ago and increased in size. About 5 years ago radium treatments were given for cancer of the lid. On 15 April 1946 the lower

lid was removed surgically for basal cell cancer. Following removal, patient could not completely close left eye. There was a lack of upward projection in the lower lid of about 4 m.m. at widest point. On August 8, 1947 the defect was corrected with a composite graft taken from left crus of helix. There was a complete take, the eye is comfortable (two weeks later), the lids close with normal effort, the cosmetic result is excellent and patient is well satisfied. (fig. E. a, b, c, d, e.)

SUMMARY AND CONCLUSIONS

1. A new application of an old technique is presented for the reconstruction of total or partial loss of the lower lid. A free composite graft is taken (by pattern) from the crus of the helix and carefully sutured into defect.

2. It is usually a one stage procedure both for the recipient and donor areas.

3. The deformity of the ear is not marked and is not objectionable, if noticed.

4. Takes are uniformally good and the results are satisfactory both functionally and cosmetically.

5. Three cases are presented. Average hospital stay three days.

6. The procedure can be used for losses of the upper lid or for ectropion.

7. The cartilage of the graft is an aid in readjusting the position of a distorted canthus.

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A NASAL SPECULUM FOR RHINOPLASTIC SURGERY

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A nasal speculum, designed to gain adequate exposure of the nasal dorsum during a rhinoplastic operation is presented. It is used to determine any irregularities or projections of the nasal bones, septum or upper lateral cartilages after a hump removal. It may also be employed for the insertion of cartilage or bone transplants to the nose.

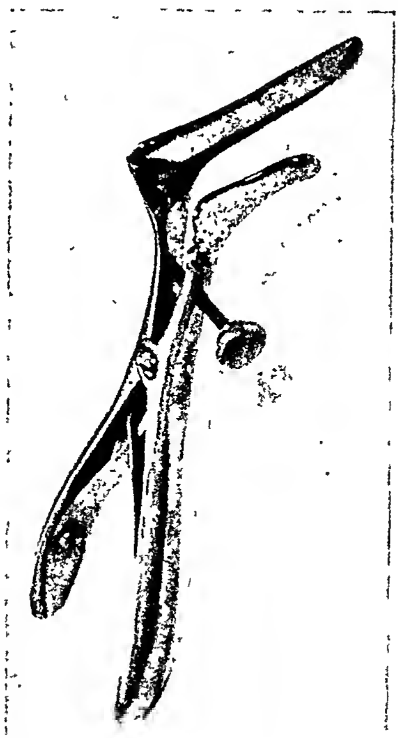

FIG. 1

The speculum consists of one long and one short blade. The longer blade is shaped after the Aufricht speculum and is inserted between the skin of the dorsum and the upper edges of the cut nasal bones and septum. The shorter blade rests against the base of the nostril and is the size of the average nasal speculum. Both blades are turned slightly outward at their extreme ends to aid in gaining more exposure (figs. 1 and 2).

The difficulty encountered in using the Aufricht speculum has been that the

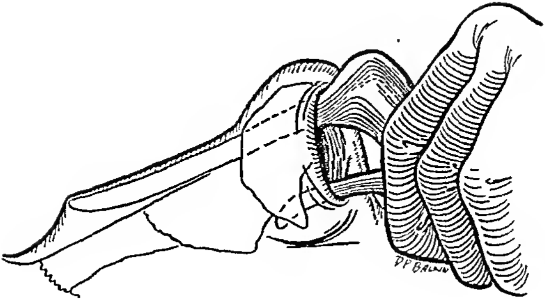

FIG. 2

base of the nostrils were drawn upward and narrowed, thereby limiting the exposure of the nasal dorsum. With the counterforce of the shorter blade against the nostril, the base of the nose can be stretched downward and outward thus allowing a clearer field of vision over the dorsum.

A NEW RHINOPLASTIC INSTRUMENT

LEONARD R. RUBIN, M.D.[1]

The removal of equal sections of alar cartilage constitutes one of the major difficulties of nasal tip surgery. This paper describes an instrument, copied from a carpenter's gauge and adapted to the nose, which facilitates the removal of equal amounts of both alar cartilages as required.

No attempt will be made here to review the surgery of the nasal tip. However, to show the usefulness of the new instrument, the standard accepted methods of removing the superior margins of the alar cartilages will be described by illustration.

METHOD I (fig. 1)

The Most Commonly Used Method

A illustrates the usual intercartilaginous incisions. B shows how the upper borders of the alar cartilages are lifted with a hook and the cartilages freed to the alar margins by means of a scissors. In C the dissection is complete and the excess alars are being trimmed. D represents another view, the shaded portions being the amounts removed.

Disadvantage

The amounts removed must be estimated by the naked eye. Turning the cartilage inside out makes it difficult to gauge accurately for equal alar trimming.

METHOD II (fig. 2)

The usual intercartilaginous incisions are made and are followed by predetermined incisions at a level closer to the alar margins. The cartilage between these incisions is dissected out, as shown in B. If the nose is to be shortened, the mucous membrane is removed with the cartilage. The overlapping lateral cartilages are used to cover the raw surfaces. If the nose is not shortened, the mucous membrane is carefully dissected from the cartilage and preserved.

Disadvantage

It is difficult to measure the exact amount to be removed.

AUTHOR'S METHOD WITH GAUGE INSTRUMENT

This method is exactly the same as Method II except that it uses the knife gauge. (fig. 3). The knife consists of a handle, (d), a shaft which is notched, (c), a sliding post (a) which can lock on the shaft by friction, and a sharp blade, (b).[2] In figure 4 the instrument used is described. Before infiltrating with

[1] From the Department of Plastic and Maxillo facial Surgery, Brooklyn Jewish Hospital, Brooklyn, N. Y.
[2] Manufactured by Edward Weck & Company, Brooklyn, N. Y.

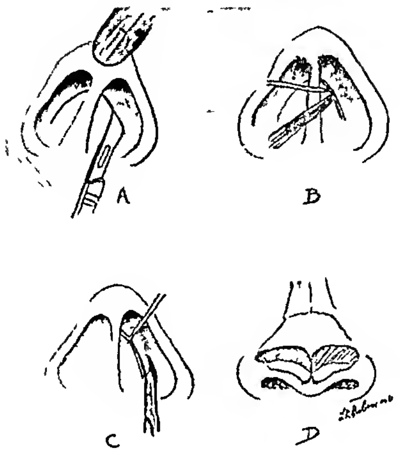

Fig 1

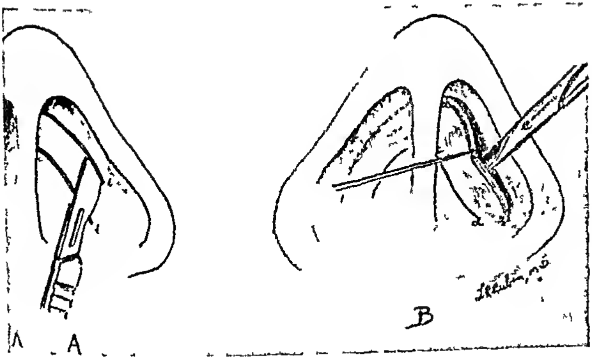

Fig 2

anesthesia, the required amounts of cartilage to be removed are marked with gentian violet The gauge is set by moving guide post (a) along notched shaft (c) so that the blade (b) is along the dotted line and can follow that line by

being guided by the post along the pyriform margin. In B the instrument is in the nose, the cutting edge incising the mucous membrane and the cartilage parallel to the alar rim. In C another view shows how the instrument works. D illustrates the cartilage portions (shaded) removed

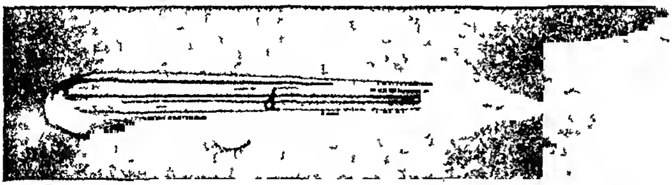

FIG. 3

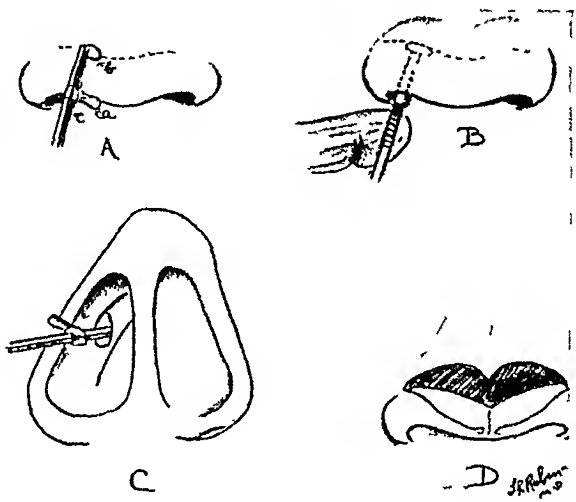

FIG 4

SUMMARY

1. Another rhinoplastic instrument is presented. It is simple to use and adjust

2. Copied from the carpenter's gauge, it is ideal for removing equal amounts of alar cartilages with rapidity and ease.

A MIRROR ATTACHMENT ON THE PADGETT'S DERMATOME AS A VISUAL GUIDE

GUSTAVE AUFRICHT, M D

AND

JAMES F DOWD, M D

Padgett's Dermatome revolutionized the technique of skin grafting and broadened its indication Thanks to this ingenious invention the profession at large is applying better grafts than ever before And, though the credit for

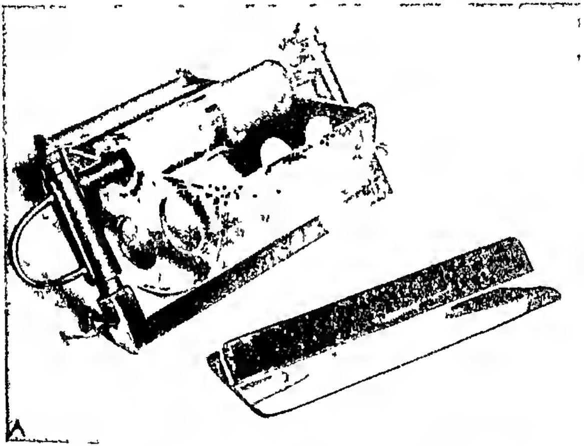

FIG A DERMATOME WITH MIRROR ATTACHMENT IN FRONT OF IT

the basic and effective adhesive principle belongs always to Earl Padgett, naturally others have been stimulated to develop modifications or improvements We wish to present such a modification which we find aids us in visualization of the cutting

On the first model the knife was held in place by two screws To follow the cutting was difficult The surgeon had to bend over the drum or depend on an assistant for guidance, following blind such commands as "The skin is detached on the left—or right," or "Press a little more on the one side or the other"

When the second model came out early in 1941, the screws were replaced by a long clip which held the blade in place on the carrying bar We found the highly polished plated metal of this clip formed an excellent mirror which served as a

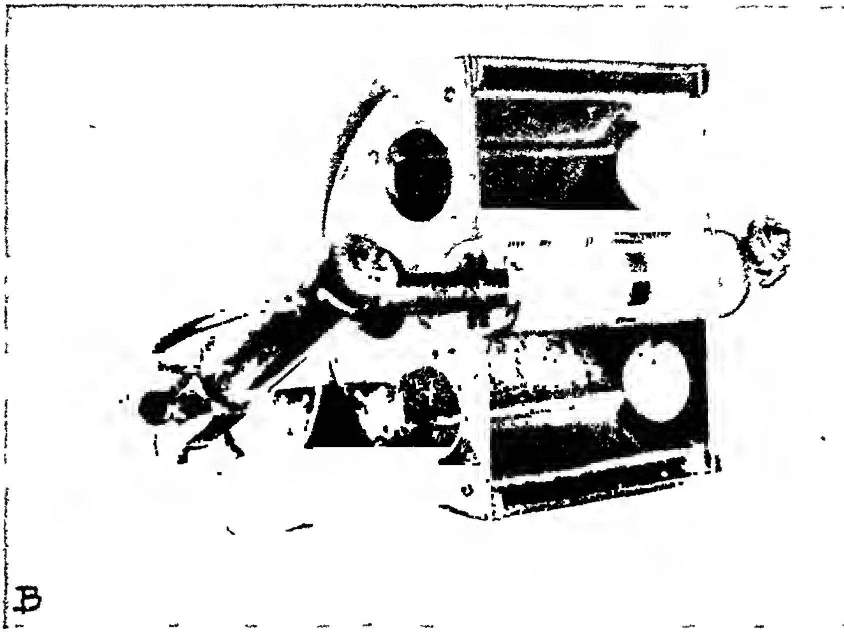

FIG B MIRROR ATTACHMENT ON DERMATOME

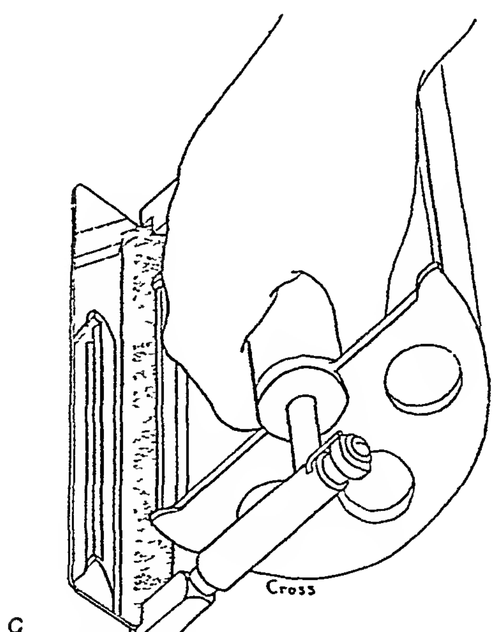

FIG. C. DIAGRAM OF DERMATOME WITH MIRROR ATTACHMENT SHOWING REFLECTION OF DRUM

visual guide in watching the progress of the peeling of the graft from the donor area. By a slight twist of the hand it became easy accurately to correct the position of the instrument at the first sign of uneveness or detachment. We mentioned the advantage of this mirror-like clip to Dr. Padgett, who was amused because he had not originally thought of the clip as a mirror.

Because of the small surface of the clip, we thought it might be practical to enlarge the mirror surface. Accordingly, we had a clip made which extended about an inch beyond the bar with the mirror set at an angle to the clip. (Figs. A to C)

No originality is claimed for this auxiliary attachment, since it was inadvertantly, in a measure, incorporated in the original Padgett Dermatome. Others also, notably Jeany, have suggested special mirror attachments. We describe this mirror only because it has proven a considerable aid in our hands by allowing the surgeon himself to follow closely the procedure of cutting the graft by constant visual observation.

A NEW DEVICE FOR EASIER SKIN SUTURING

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Frequently, when making repairs of the borders of skin wounds, surgeons—otherwise very competent—apply hemostatic forceps at both ends, distribute others along the wound, handle the borders with toothed forceps and feel surprised upon obtaining a defective scar.

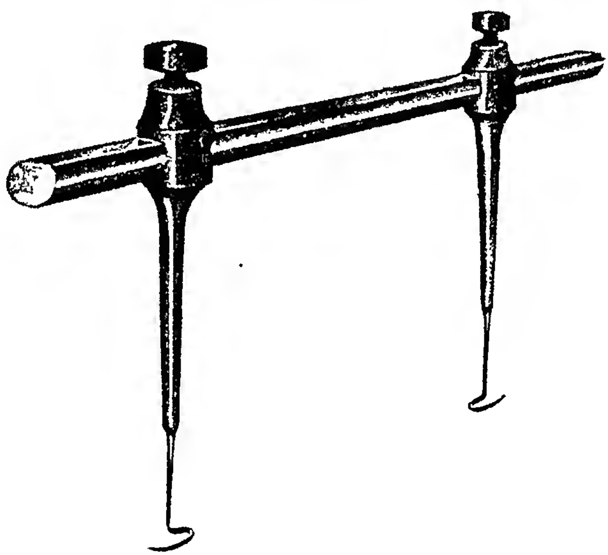


FIG. 1

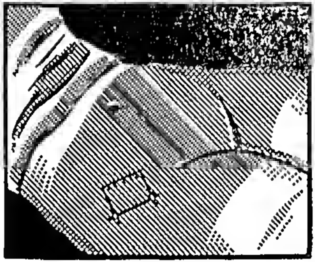
The author has emphasized on several occasions the necessity of using a gentle technique in tissue repairs[1] avoiding thus all kinds of trauma and has stressed the importance of eliminating the use of forceps in handling skin borders, because they destroy cellular groups which have to be repaired with fibrous tissue which, added to that generated to repair the original wound, will result in a defective visible scar.

He has also pointed out the necessity of making the borders coincide exactly with one another, in order to make the suture technique easier and correct. To that effect there has been recommended the application of two hooks one at each extreme of the wound, which held by an assistant and exerting an outward pull, unite both borders.

[1] El Tratamiento Actual de las Heridas de la Cara.—Dr. M. González Ulloa. Revista Mexicana de Cirugía, Ginecología y Cander.—Año XI—No. 2

Following, is a description of the device the author has had constructed to replace the hooks mentioned previously. It has the following advantages: 1)

Fig. 2



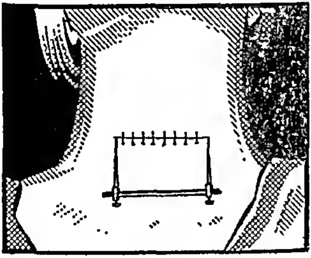


Fig 3

Holds itself in place 2) exerts the desired outward tension, 3) co-apts the borders satisfactorily and 4) *eliminates the need of an assistant.*

It consists (fig. 1) of a rod truncated in a section of its periphery on which slide two adjustable bolts, each having a hook perpendicular to its axis. The hooks are held in place, at will, by means of two nuts, which are tightened against the flat section of the rod. The device is made of a nickel-steel alloy which makes it rust-proof.

To apply it, one of the hooks is placed at one extreme of the wound and the other slid and tightened at the point where the necessary tension and the correct adaptation of the borders are obtained.

Each instrument is constructed with two rods, a short one for plastic (figs. 2-a and 2-b) and a long one for general surgery. (fig. 3)

It is called DERMO-COAPTOR. In practice, the author has reduced suture time, simplified the technique and turned suturing into an exact procedure. It has also eliminated an assistant from the operating team.

These advantages have encouraged the author to present this device to the medical profession trusting that it will constitute an aid toward the simplification of the complex task which surgeons are compelled to face.

THE CHONDROJET

A Simplified Method for Handling of Diced Cartilage

E. HOYT DE KLEINE, M.D.

Buffalo, New York

For reconstruction of depressions or deficiencies in the rigid framework of the face, insertion of a firm "filling" material is required. Many substances have been employed for this purpose. Several autogenous living materials have been utilized as grafts, including bone, cartilage, fascia, dermis and fat. Others have employed non-living materials of human or animal origin, such as boiled bone, preserved cartilage, ivory, gutta percha and preserved fascia. Several totally foreign materials, such as, paraffin, silver, gold, platinum, vitallium, tantalum, celluloid, lucite, and other plastics have also been used.

From this long list of available materials, human cartilage has emerged as the preference of most surgeons. Cartilage may be used as living autogenous *grafts* or as preserved (non-living) homogenous *implants*. Cartilage can be introduced as a carved block or as a mass of diced particles (1). This latter method is becoming increasingly popular for certain types of reconstructions. The purpose of this paper is to describe a new instrument and technique which facilitates the handling of diced cartilage.

DISADVANTAGES OF USUAL TECHNIQUES

The term "diced cartilage" implies material chopped into multifaceted particles, generally about 1 to 3 mm. in diameter. Customary methods of burying this material subcutaneously (or deeper) require incisions directly overlying or in close proximity to the defect being filled. Rather large incisions are usually employed for introduction of cartilage with a spoon. It is sometimes possible to use small incisions by the slow laborious introduction of a few fragments at a time.

These methods have certain disadvantages:

1. Incisions directly over recipient sites are more likely to allow extrusion of fragments if infection or marked foreign body reaction is encountered. This is particularly important when large masses of cartilage are being introduced or when cartilage must be inserted under a thin subcutaneous cover.

2. Incision directly over the defect is frequently not in the best location for cosmetic purposes. Scars further from these sites may offer better concealment.

3. Large incisions are undesirable on the face, and are more likely to permit extrusion of cartilage fragments.

4. Bacterial contamination is the deadliest of enemies to cartilage. Skin is never well sterilized and it seems undesirable to contaminate cartilage from skin surfaces at wound margins.

5. The time required at operation is also important. In addition to length of anaesthesia, the patient's comfort and time consumed by operating room

personnel warrant consideration. Speedier methods not interfering with results are always more desirable.

USE OF THE CHONDROJET

After Peer's introduction of diced cartilage (1), we conceived the idea of introducing this material through a tube, using small incisions not directly over the

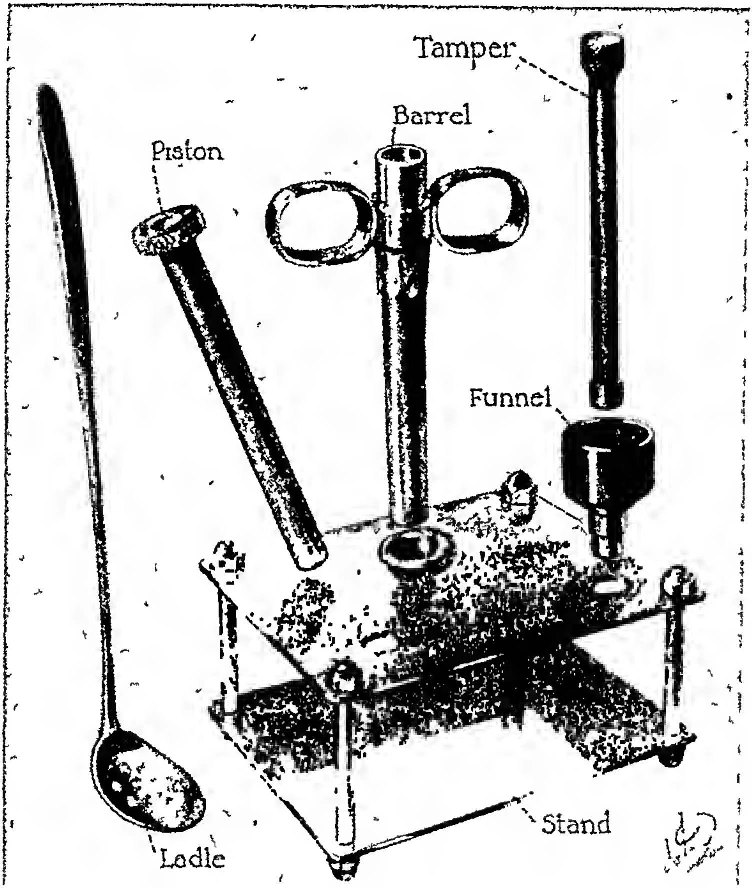


Fig. 1

The Chondrojet consists of a tube-like barrel with finger grips and syringe type piston. A perforated ladle facilitates handling of diced cartilage The stand, funnel and tamper are used for loading With this instrument, large amounts of cartilage may be introduced through a small incision not directly overlying the recipient site.

recipient site. Many types of tubes were tried—both rigid and flexible, of various diameters and lengths, and with varying mechanical details. A straight metal tube about 1 cm. in diameter and 10 cm. long with a syringe type piston and finger grips best answered the problem. Filling of the tube was a laborious

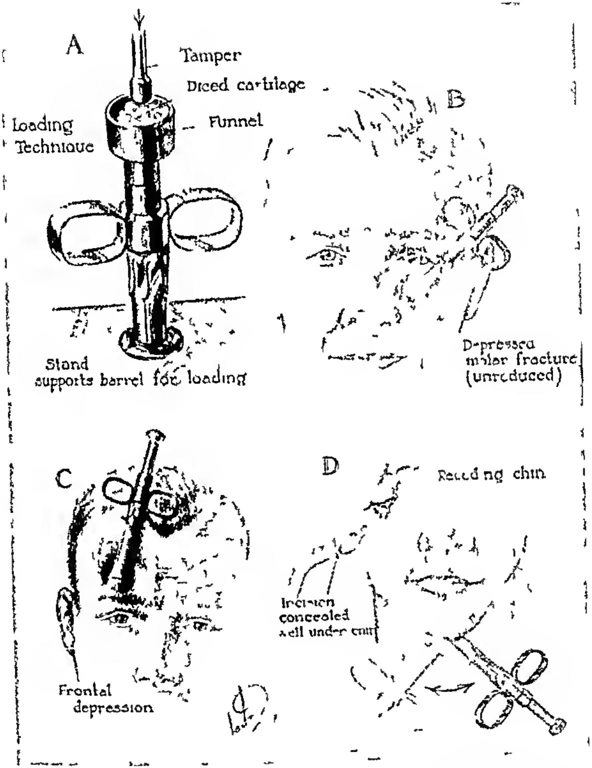


FIG 2

(A) Technique of loading the Chondrojet With the barrel vertical (in the stand), [illegible] with a tamper [illegible] sions along natural creases [illegible] e elevated and common in [illegible] cisions can be used for the two procedures

(C) For frontal depressions, incisions above the hairline may be employed when there [illegible] l midline incisions concealed below the anterior mandible can be corrected through the same incision by placing cartilage lateral to the chin on one side or both

procedure and much cartilage was often spilled. The addition of a funnel and tamper for loading eliminated these difficulties. An instrument of these specifications has been constructed and designated as the *"Chondrojet"*. In its present form it is made of stainless steel and is equipped with a stand to hold the apparatus vertically for loading (fig. 1).

With the barrel upright on the stand, the piston is removed and the funnel is fitted into the collar at its upper end. Diced cartilage is placed in the funnel and pushed into the barrel with the tamper (fig. 2A). The barrel should not be filled closer than 1 cm. from the top (capacity is about 7.5 cc.). The funnel is then removed and the tip of the piston reinserted.

Before loading the Chondrojet, incisions and recipient pockets are prepared. This permits clotting and cessation of oozing before cartilage is inserted. We usually select a site for incision a few centimeters away from the recipient area. Scalp, eyebrows, old scars, natural creases and shadowed areas below the jaw are

Fig. 3

Receding chin corrected with the Chondrojet. About 15 cc. of diced preserved cartilage 'ere inserted at one time through a 2 cm incision concealed under the mental tip.

ypical elective locations (fig. 2) and incisions 2 cm. long are sufficient. From his opening a tunnel to the recipient site is dissected. At its end a pocket is pened up for reception of the cartilage. The loaded Chondrojet is introduced hrough this tunnel and its contents extruded by pressure on the piston. Several ..njections may be required for large defects and it is practical to insert 25 cc. or more into one recipient site through a single small incision. After the incision is closed tightly, the cartilage mass is moulded by finger pressure to a smooth contour and pressure dressings are applied.

EXPERIENCE WITH THIS METHOD

Introduction of diced cartilage with the Chondrojet has been carried out seventeen times on eleven different patients and results have been most gratifying. Operative time has been reduced over 50%. No major infections were encountered and loss of cartilage fragments by extrusion was negligible. All scars were acceptably inconspicuous. Serous fluid accumulations occurred

frequently, especially when large amounts had been introduced It is our practice to evacuate such fluid pockets regularly with a sterile syringe and 23

FIG 4

Another example of receding chin corrected by this method Note the widening secured by cartilage placed laterally (both here and in fig 3)

FIG 5

gauge needle No damage to cartilage implants occurred when this was carried out

Suitable locations for diced implants with the Chondroject are numerous Receding chins comprise one of the most gratifying groups (figs. 3 and 4) Through

small incisions under the mental tip, large amounts of cartilage can be introduced along the lateral margins of the chin as well as over the tip (fig. 2D). One of the frequent uses has been for depressions in malar and frontal areas (fig. 2B, 2C, 5 and 6). For one patient with severe destruction of the entire left upper facial quadrant, nearly 50 cc. of diced cartilage were successfully introduced. In two cases we have elevated depressed orbital floors with subperiosteal packing of diced cartilage, which we prefer to wedges previously employed. In two cases cartilage was inserted for infra-malar depressions resulting from fat destruction (fig. 7). This results in abnormal rigidity of tissue but gives as satisfactory contour as any other method tried. In three cases, asymmetry of the mandible

FIG. 6

Filling of deep frontal depression through old scar. The second photograph was taken one month after cartilage insertion and considerable induration was still present.

was corrected by cartilage injection at the site of deficiency. Two of these required a small insertion on one side of the chin and the other required a large injection at the angle.

Local infiltration with procaine was used in nearly all of our cases. In every instance preserved cartilage implants were employed. We use rib cartilage procured at clean autopsies and preserved in merthiosaline under refrigeration as recommended by Pierce and O'Connor (2). Dicing is done prior to operation by a nurse trained in this technique. Cartilage is dipped from the preservative solution with a sterile perforated ladle (fig. 1).

We cannot discuss in detail the comparative advantages of living cartilage *grafts* versus preserved cartilage *implants*. However, it does seem worth reporting ten years experience with preserved cartilage in which clinical results appear

to equal anything reported with living grafts Of 100 implants (in past 7½ years) we know of only four (in three patients) which were unsuccessful due to absorption or extrusion, and there were no gross immediate losses with infection or overwhelming foreign body reactions It is the author's opinion that the unsatisfactory experiences reported should not be attributed to the fact that cartilage was *not living* Rather, I believe it was the result of unsatisfactory *methods of preservation*, usually with strong antiseptics which probably cause some chemical change in the hyaline matrix I have tried merthiosaline without refrigeration, aqueous zephiran with refrigeration, and alcohol, all of which did prove unsatisfactory In fact, most of the few failures in this series occurred while one of these other preservatives was being tested It should be noted that in nearly

FIG 7

Sunken infra malar region (from fat destruction) filled with diced cartilage Although the cheek feels too firm, contour is satisfactory

all successful series reported (3, 4, 5), merthiosaline and refrigeration were advocated

In one patient (fig 5) diced cartilage was introduced under a thin subcutaneous cover for a defect of the infraorbital ridge Roughness of the surface was grossly evident One year later the skin was elevated and the surface of this cartilage mass was carved to a smoother contour This was preserved cartilage, but the individual particles still had sharp unrounded corners and had the white glistening appearance of normal cartilage Peer (6) examined this material microscopically and reported no absorption nor foreign body reaction except around cotton fibers found in the specimen This was the result of drying cartilage with gauze before we had a funnel for loading the Chondrojet—a practice now discontinued

SUMMARY

1. Use of diced cartilage for filling contour defects of the face is increasing in popularity.

2. With a new instrument, the Chondrojet, diced cartilage is easily introduced in large quantities through a small incision not directly overlying the defect.

3. Use of the Chondrojet reduces operative time, and visibility of residual scar.

4. Results with this technique have been uniformly good in a wide variety of cases.

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January 1948

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

SHOCK

Birchall, Robert, Capt.: The Shock of Battle Wounds; A Review of the Treatment in 2,000 Casualties. *Am. J. Surg.* 72: 291, Sept. 1946.

Birchall's review of 2,000 battle casualties in which all the injured were treated for preoperative shock, followed an established plan of management. This included frequent detailed evaluations, classification as to degree of shock, treatment and eventual outcome. Autopsy was performed on the 251 who died. Hypertension was regarded as evidence of arteriola over-compensation, and those so affected were treated for shock to prevent a marked drop in blood pressure with anesthesia induction. Bradycardia was found in 12.4 per cent of those who subsequently died, and appeared to be a somewhat ominous sign. The use of alcohol with its secondary vasodilatation is condemned in the treatment of shock. The amount of fluid required may be large, and its adequate administration often depends upon clinical judgment, due to confusing laboratory, clinical, pulse and blood pressure findings.

Other than burn shock, the most severe cases resulted from massive hemorrhage. Blood was found to be the most effective agent in combating shock. Birchall feels his experience has demonstrated that crystalloid solutions are more effective in the management of shock than plasma and especially so in view of their availability and ease of administration. Hypertonic plasma was useful in pulmonary edema and to correct

hemoconcentration after adequate fluid had been given.

In those patients who remained in shock after adequate fluid replacement and who required surgical intervention to alleviate the factors of shock, the mortality was high, reaching approximately 40 per cent. The most frequent causes of failure to respond to shock therapy were found to be positive intrapleural pressure, acute gastric dilatation, poorly splinted fractures, exsanguination, gas gangrene, and the absorption of toxigenic substances.

Among 6,000 blood transfusions, there were 101 severe reactions, four of which were fatal, while three others probably contributed to eventual death. Type O blood may be given as an emergency measure while crossmatching is being done, but thereafter only crossmatched blood should be used. Under the circumstances of this study, Rh factors were not considered. Alkalinization to prevent reaction was not found to be advisable.

Editorial Comment: This practical and vast experience is particularly significant in that it illustrates the greater value of whole blood in combating shock, the necessity for fluid replacement, the enormous amount often required, and the usefulness of crystalloid instead of plasma. Of singular importance is the complicated nature of shock determination and the complete inadequacy of any simple guide to the existence of shock.

Thompson, James E. M.: Clinical Manifestations of Local Shock and the Treatment. *Surgery 20:* 498, Oct. 1946.

As pointed out by Thompson, local shock is a clinical sequence of pathological changes exhibited after severe injuries of the extremities. Such shock is characterized by local vasospasm which may extend to involve a considerable part of the extremity. This can lead to degeneration and local death of the tissue before circulatory integrity can be re-established. One of the most valuable methods of treatment is sympathetic block, although it is not a panacea for all the grave complications of serious injury to the extremities. Very striking results were obtained in a series of 48 instances of the use of stellate and lumbar sympathetic block, with no mishaps. This valuable method is used all too infrequently; the surgeon repairing trauma should become familiar with this important therapeutic and prophylactic measure.

BURNS

Brush, B. E., Lam, C. R., and Donka, J. L.: Wound Healing Studies on Several Substances Recommended for the Treatment of Burns. *Surgery 21:* 662, May, 1947.

In this study Brush, Lam and Donka evaluate, under controlled conditions, commonly used local burn preparations in terms of their influence upon the rate of healing of approximately uniform burn lesions in guinea pigs. Similar experimental and control lesions were made in each animal, and the wound size was followed by cellophane and paper tracings. Dressings, re-applications of the agent studied and new tracings were made of both control and treated lesions every 2 days. The results showed that the lesions on which petrolatum gauze and a stearate grease (mineral oil and aluminum monostearate) were used healed with approximately the same rapidity as the control lesions covered with dry gauze. Two types of carbowax preparations and Biodyne ointment showed slight delay of wound healing. Tannic acid solutions, 5 per cent, two types of tannic acid jelly, proflavine dihydrochloride and a hydrosulphosal solution definitely inhibited wound repair.

Editorial Comment: This study constitutes further documentary evidence that the rate of healing is not increased by the addition of chemicals above that found with natural optimal wound conditions. Again it can be said that no substance increases the normal rate of repair although some of the preparations tend to lessen or even eliminate some of the factors which inhibit healing.

Sulzberger, M. B.; Kanof, A. and Baer, R. L.: Studies on the Acid Debridement of Burns. *Ann. Surg. 125:* 418, Apr. 1947.

The search for non-injurious and selective chemical aids in removing slough from open lesions has culminated in the pyruvic-acid starch paste method of Connor and Harvey. This study by Sulzberger *et alii* was designed to compare the method of Connor and

Harvey with that of others who worked with controlled uniform full thickness burns in human subjects, to evaluate other vehicles to replace starch paste, to discover a more stable and procurable acid than pyruvic, and in general to enlighten this phase of wound management. Symmetrical burns were made on the flexor surfaces of the fore arms of human subjects, one arm being treated by the standard control method. The lesions were observed daily, the day of debridement and complete epithelization being noted. The agents under study were not applied until the early exudation had decreased. After debridement, a sulfadiazine cream was used until complete healing had occurred.

Slough usually separated on the third or fourth days of acid treatment, but acid debrided lesions gave somewhat larger ulcers and subsequent scars than non debrided lesions. However, the scar was smoother and more pliable in the former and the incidence of infection was almost nil. A follicular dermatitis was frequently seen on the surrounding skin but this disappeared when the acid was discontinued.

Acid debridement proved superior to all other methods which were evaluated, including the untreated control, blank starch paste and various sulfonamide preparations, in a series of over 1 500 wounds.

In evaluating the effect of acids other than pyruvic, it was found that only phosphoric worked as well in low concentrations. While mordilic, lactic, tartaric and citric acids were equally as effective in high concentrations they were found to be too irritating to the surrounding skin. Tartaric acid was the best, but hydrochloric acid was ineffective. In general, the more weakly dissociated acids with a larger reserve of hydrogen ions, which indicate their buffer capacity, are able to maintain the lower pH longer and more effectively. At the same molarity, again pyruvic and phosphoric acids were superior.

Since starch paste is a variable substance which requires an elaborate and time-consuming daily preparation 61 other vehicles of a gel type were investigated concerning their irritant qualities and effective diffusion of acid. It was found that methyl cellulose, K Y jelly, and pectin glycerine Ringer's solution gel combinations were equally as effective as starch paste, without its disadvantages. It was also found that seven combinations of dry powders containing methyl cellulose or hydroxyethyl cellulose formed effective gels upon the addition of water.

Editorial Comment As indicated previously by Connor and Harvey, acid debridement will produce granulations suitable for grafting in 3 to 5 days. This well executed evaluation of chemical debridement constitutes a definite advance in burn management.

SKIN LESIONS

Barker, L P Lupus Vulgaris Occurring in a Skin Graft *Arch Dermat & Syph* *54* 758, Dec 1946

A case of a German woman who had lupus vulgaris on the side of the face, nose and ear for 50 years is reported by Barker. Thirty five years previously the cheek had been irradiated. In 1938, two tumors were removed from the cheek with a larger area of adjacent tuberculous skin. A pedicled flap was applied to the defect. Two years later lupus appeared in the flap and then developed in other areas.

In discussion it was pointed out that the lupus was not entirely eradicated when the tumors were removed. The remark was made that the plastic surgeon should be advised to excise wide of diseased tissue because there are satellites of lupus nodules beyond the area of clinical involvement.

MacKechnie, H A Small Tumors of the Skin *Canad M A J* *56* 56 Jan 1947

Those skin tumors most commonly met with in everyday practice are briefly discussed by MacKechnie. Concerning hemangiomas he states that they very often disappear spontaneously, but unfortunately one is not able to ascertain which ones will disappear. Freezing by carbon dioxide snow or radiotherapy is advised.

Treatment of the common benign pigmented nevus depends upon the location, the size and thickness of the lesion, and the presence or absence of hair. Surgical excision is unnecessary except where there is a suspicion of malignancy. Electrodessication cautiously employed to prevent scar

ring is preferred. Excision is advised for benign lesions on the face and extremities which are subject to trauma. Sudden changes in color, increase in size or inflammatory change call for immediate surgical intervention. Wide surgical excision is the only satisfactory treatment of malignant melanoma, opinion differing concerning the value of heavy roentgen-ray treatment following.

Fibromas are treated by excision. The treatment of choice for the common wart is roentgen ray therapy, particularly in large solitary or closely grouped lesions, or curettage followed by fulgeration of the base. Granuloma pyogenicum is treated by roentgen rays. Senile keratosis is very subject to malignant degeneration, the earliest indication of which is a surrounding inflammatory appearance with formation of a scab. On removal this leaves a sharply defined erosion. Malignancy is generally of the basal-cell type. Observation with biopsy if there is suspicion of malignancy, with curettage and fulguration or carbon dioxide freezing of the very small lesions is believed the most satisfactory treatment.

Attention is called to the fact that in the early stages there may be no clinical difference between basal-cell and squamous-cell carcinoma. All lesions suspected of malignancy should be subject to a biopsy. The treatment is excision or radiotherapy. Reexamination should be done at 3-month intervals for a year, then at less frequent intervals for a further period of at least 4 years.

HARELIP AND CLEFT PALATE

Vaughan, H. S.: The Importance of the Premaxilla and the Philtrum in Bilateral Cleft Lip. *Plastic & Reconst. Surg. 1:* 240, Sept. 1946.

According to Vaughan, far better results are obtained by using the philtrum for the central portion of the lip, than in the older method of adjusting the anterior sides of the cleft around a philtrum denuded of its alar vermillion. The latter results in an elongation from above downward and a shortening from side to side. When the premaxilla shows extensive anterior displacement, it must be retroplaced and held in position. Care must be exercised not to replace the premaxilla too far backward, as the lip must have ample support, and the repaired lip exerts some pressure. The alveolar borders and premaxilla are not united until the palate cleft has been repaired. Revision or adjustment of the vermillion border is deferred for one or 2 years.

Lee, Ferdinand C.: Orbicularis Oris Muscle in Double Harelip. *Arch. Surg. 53:* 407, Oct. 1946.

Lee reports that serial sections of the left side of the upper lip from a 5-month old human specimen having double harelip were made in order to study the orbicularis oris muscle. This muscle is found to be well developed at the corner of the mouth, but quickly becomes thin and fragmented at the ala of the nose. It is moderately effective in forming a barrier to keep the buccal glands in a posterior position in the lip. No support is found for the view that there is a large concentration of purely sphincter muscle fibers at the corner of the mouth. Photographs of sections are presented for accurate record.

Fogh-Anderson, Paul: Inheritance of Harelip and Cleft Palate. Nyt Nordisk Forlag-Arnold Busck, Copenhagen, 1942.

This book by Fogh-Anderson contains a careful, thorough analytical survey of 703 patients operated upon for harelip, cleft palate, and isolated cleft palate. Six hundred and twenty-five of these were treated in one hospital (Diakonissestiftelsen Hospital, Denmark) where all patients with these types of defects throughout Denmark are centralized. Consequently, the opportunity for objective study of this problem is ideal. Fogh-Anderson made excellent use of this opportunity, and, on the basis of complete statistical studies, presents certain scientific conclusions.

The conditions studied consist only of clefts of the face, primarily harelip, harelip with cleft palate, and cleft palate alone. The author attempts only superficial analysis of what he terms "microforms," or minor clefts, which may be only tendencies to cleft formation. Morphologic classifications of various types are discussed, but the author simplifies his terminology to the follow-

ing (1) harelip, (2) harelip with cleft palate, and (3) isolated cleft palate

The frequency of the incidence of harelip and cleft palate in Denmark is discussed, and further, the frequency of the different morphologic types is analyzed The total number of patients with harelip and/or cleft palate In Denmark is estimated at 4000 The frequency at birth is 1 665 (Davis' figures for frequency at birth is 1 1525 in the United States) Comparative figures by various authors throughout the world are presented

A chapter is devoted to a discussion of the embryology of cleft formation, and another presents the earlier works on the genetics of harelip and cleft palate Fogh Anderson admits that the final solution has not been attained Etiological factors are considered, those of heredity playing the most important role He terms this, "Hereditary Disposition"

In presenting his own material, derived from the Surgical and Pediatric Services of Diakonissestiftelsen Hospital, and from the State Institute for Patients with Defects of Speech in Copenhagen, Denmark, the author analyzes all 703 of the cases The work was completed while Fogh Anderson was Assistant to the University Instituto for Human Genetics

Many of the family pedigrees are tabulated in order that the reader may follow the familial tendencies in the formation of various types of clefts The conclusion is drawn that there are two different malformations with no genetic connection, viz , (1) harelip with or without associated cleft palate, and (2) isolated cleft palate

Harelip (with cleft palate) occurs most frequently in males, whereas isolated cleft palate is found most frequently in females Harelip is found most frequently on the left side (most authors agree that about 75 per cent occur on the left side) Approximately 10 per cent of children with harelip or cleft palate have other severe malformations at birth Most of these are either stillborn or die shortly after birth There is no proof that relatives of patients with harelip or cleft palate show more than the normal tendency or frequency of malformations in general

On the basis of twin studies the conclusions are drawn that in monozygotic twins the frequency of concordance in the case of harelip (with cleft palate) is greater than in dizygotic twins, and that isolated cleft palate is genetically independent

Tabulating the incidence of the appearance of harelip (with cleft palate) among relatives shows that heredity is an important etiological factor both of harelip (with cleft palate) and isolated cleft palate

The occurrence of harelip and cleft palate in lower animals is presented briefly

In the final chapter, Fogh Anderson considers the practical aspects of his conslusions regarding Eugenics On the foundation of the extensive studies made, he answers questions of vital importance and interest to patients with harelip and cleft palate, their parents and relatives In the case of harelip (with cleft palate), or isolated cleft palate induced abortion or sterilization in Denmark is not generally recommended If parents are anxious for induced abortion, it will be agreed upon when the chance of these deformities is great, i e , when one parent and at the same time one or more children are affected

Dsplyn, Phyllis F L Vinesthene Anesthesia for Repair of Harelip and Cleft Palate *Brit M J 2* 117, July 27, 1946

Daplyn reports on 50 patients with harelip and cleft palate, anesthetized with gas, oxygen and vinesthene The results from the use of vinesthene were uniformly good, there being no chest complication Only two patients with cleft palate vomited very slightly In every case healing was by first intention The opinion of Ward Sisters was that vinesthene was preferable to ether for these patients, and that the children were much brighter and in better general condition than when other anesthesia was used

Stine, George H , and Crisp, William H Microphthalmos Harelip and Cleft Palate *Am J Ophth 29* 1309, Oct 1946

Stine showed a Kodachrome picture of an infant born with a major cranial deformity and other associated malformations, including bilateral microphthalmia

Crisp reported a case of microphthalmia associated with marked corectopia.

MISCELLANY

Pickrell, Kenneth L.; Baker, Horace M., and Collins, John P.: Reconstructive Surgery of the Chest Wall. *Surg. Gynec. Obst. 84:* 465, Apr. 1947.

There are many conditions of the chest wall which may not respond well to general surgical procedures or may even be considered inoperable but which can be greatly benefited by the application of the more specialized technics developed in plastic surgery.

Pickrell, Baker and Collins describe the treatment employed in 4 such conditions, namely: (1) 2 cases of recurrent carcinoma of the breast, previously considered inoperable, (2) sarcoma of the chest wall, (3) persistent bronchial fistula, and (4) hypertrophy of the breast.

Discussing the general surgical principles applied in breast cancer, the authors state that the operation originally conceived by Halsted remains the standard procedure for radical mastectomy since it is based on sound surgical and pathological principles and is applicable to most cases in which the disease has not passed beyond the scope of operability. On the other hand, they claim that few operations have been designed for the eradication of recurrent cancer of the breast. The 2 cases of breast cancer described here were considered inoperable. Pickrell and his colleagues, however, made use of skin grafting technics and obtained satisfactory results. In one case, the cancer had invaded the underlying ribs so that a large portion of the left chest wall had to be removed, exposing the pericardium and left pleural cavity. In the repair, the pericardium was tacked to the intercostal muscles and fascia at the margin of the defect. Two heavy split-thickness skin grafts cut from the thigh were placed directly over the pericardium and the adjacent defect, which measured 8 by 9 inches.

The authors believe this is the first time that a skin graft has been applied directly to pericardium.

In the other case, the extent of the recurring cancer required removal of part of the left chest wall, and exposure of the great vessels of the base of the heart. A direct single pedicle flap from above the right breast was incised and slid over the defect.

The most common malignant tumor arising from the chest wall itself is sarcoma. Pickrell *et alii* describe a case of huge sarcoma of the posterior chest wall which they excised widely, applying two heavy split-skin grafts to cover the defect.

They give a brief description of the etiology and usual methods of treatment applied to bronchial fistulas, noting especially the difficulties encountered. By incising the pectoral muscles along the sternum up to the clavicle and sliding the muscle into the defects, they were able to obliterate a group of fistulas which had not responded to 4 previous operations.

Reconstruction of enlarged breasts is indicated when the hypertrophy leads to disfiguring or disabling deformity, as demonstrated by the occurrence of gravid hypertrophy in a young woman on whom a mammoplasty was performed after removal of a 32-pound breast.

HEMANGIOMA: AN EVALUATION OF TREATMENT BY INJECTION AND SURGERY

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INTRODUCTION AND HISTORICAL

From earliest times "birth marks", so frequently obviously deforming, have been of considerable concern to the afflicted and of interest to their associates. Folk-lore has attributed their occurrence to disagreeable or prolonged impressions received by the mother during pregnancy (Rolleston). A belief in this doctrine was once firmly held by the medical profession as is shown by Daniel Turner (1714):

> Thus it is made apparent by a Multitude of Examples, how manifest and great an Empire the *Fantasy* of a pregnant Woman has over the Blood and Humours together with the Spirits of her Body, and how by their Ministry she is able to give not only Monstrous shape and Figures to that of the more tender *Foetus* but to communicate Diseases also.

Dan McKenzie (1927) points out that sexual intercourse with an animal or with a spirit or demon has also been held responsible. Wine-coloured nevi were said to be due to conception having taken place during menstruation (Lean 1903). Moles on or near the genitals were said to be indicative of ability in duty, vigour in love and many children. The well-known lines uttered by Chaucer's Wyf of Bath

> Yet have I martes marke upon my face,
> And also in another privee place,

indicated the popular belief, exemplified many centuries later by Casanova, that facial nevi were always associated with nevi in the genital region. Among the Flemish peasants there existed a quaint belief that to remove birthmarks from a new-born babe the mother must during nine consecutive mornings following the birth of the child lick these birth-marks (Cantero 1929).

Hemangiomas generally pursue a benign course but if untreated, frequently grow more rapidly than commonly suspected, thus producing cosmetic deformities. Occasionally, there may be rapid acceleration with destruction of an important anatomic part such as the eye, nose, ear, lip, cheek, neck, or a large portion of the skin of the scalp, neck, back, and extremity may become involved. Ulceration and secondary sepsis may become the problem. Thrombosis of a large vessel may cause sudden increase in size. Secondary degeneration does occur. When rapid growth takes place as in the aggressive hypertrophic type, it

is fundamental to immediately consider surgical excision in order to avoid further destruction, unless one elects injection therapy. Establishing a positive diagnosis by biopsy is one excellent reason to elect surgical excision in contrast to injection. Rarely, one may encounter a case which on biopsy may appear benign histologically but which, as subsequent history discloses, is malignant due to metastasis (case no. 9). Later we will present a case (no. 4) of a patient with gross hemangioma of the eyelids and orbital cavity, in whom we felt the evidence warranted such study before instituting therapy. Occasionally, the growth may become diffuse and involve an entire extremity (case no. 8) or establish connection with a large blood vessel and become destructive or dangerous because of severe hemorrhage. In many instances the apparently discrete areas may be deceptive in that their extension can be remote to the area defined by the localized, slightly raised, red tumor. In one case (no. 3) which has come under our care the patient had an area on the bridge of the nose which on injection showed diffuse thrombosis over the central area of the forehead. This may well explain the occurrence of subsequent hemangiomas following apparent cure of the mother tumor whether by surgery, injection, or other therapeutic methods employed. Obviously, if the "mother" tumor is destroyed, but the connecting pseudopods extending into adjacent tissue remain, it will probably show evidence of growth later even though invisible at the time of treatment.

Various physical methods at scarification with the creation of thromboses have been attempted throughout the years. Surgical excision of the involved area has for several centuries been practiced and Peyton and Leven accredit Lallemand with repeated partial excision in 1835. In the same year, Pauli employed tattooing in the treatment of nevi, "congenital purple plaques" and other lesions of the skin.

The cautery was used as far back as 1854 and in the same period injection therapy was practiced. Ferric chloride, and other sclerosing solutions such as boiling water, alcohol, urethrane, and more recently sodium morrhuate have been used.

Carbon dioxide snow, which by freezing the endothelial lining cells causes thrombosis, was first introduced by Pusey in 1907. Actually the methods have not been of recent discovery but the indications have become more clearly defined and the esthetic results considerably improved.

INCIDENCE AND DISTRIBUTION

In Watson and McCarthy's series of 1056 cases about 73 per cent of the patients presented evidence of tumor at the time of birth and 85 per cent of the lesions became apparent before the patient was one year of age. The female is affected two to three times as often as the male. Although no acceptable explanation for this higher female incidence has ever been offered, Watson and McCarthy have suggested that "hemangiomas may in some fashion be related to the female sex hormone, and in this connection it is of interest to note that a hemangioma may start or increase rapidly in size with the onset of the menses or at the beginning of pregnancy."

Fifty-six per cent of all hemangiomas occur on the neck and head and the distribution is about: head 52 per cent, neck 4 per cent, trunk 23 per cent, extremities 19 per cent, and genitalia 2 per cent. Thrombosis with phlebitis is said to be common.

PATHOLOGY

From the point of view of the pathology we are thoroughly in agreement with Foot who states: "Some of the lesions that are called 'hemangiomas' are definitely neoplasms, while others may, in some cases, represent congenital anomalies....There has been much useless classification in connection with blood-vascular tumors, and it is time for simplification, as nothing is to be gained by insisting upon the use of some of the currently employed terms." We would further state that, clinically, there is no considerable evidence that the more complicated classifications are useful because such diagnostic differentiation on the basis of descriptive terms does not in any way modify the decision with regard to therapy.

It is generally accepted that hemangiomas are tumors of independently growing blood channels with their origin in embryonic rudiments of mesodermal tissue. Histological studies tend to confirm Ribbert's original theory that a "hemangioma, with the exception of the racemose type, has no anastomotic connection with surrounding vessels and possesses only one afferent and one efferent vessel."

Again, we feel that the vascular channels, their arrangement, and the amount and character of the surrounding stroma is the most logical basis for classification. Angiomas may develop in capillaries and exhibit a capillary structure, that is, they will be composed of little more than vascular endothelium with a minimal amount of supportive stroma. Or, they may be composed of large lacunae, usually with venous connections (rarely arterial), surrounded by a negligible amount of stroma.

When the tumors arise from small arterioles, the walls of the anastomosing plexiform vessels are complete in fibrous and adventitial elements. When arising from larger vessels they are of similar structure, but communicate with the surrounding vessels and they give a definitely palpable "worm-like" mass, and are commonly called the "cirsoid" or "racemose" type.

If the adventitial tissue is the site of neoplasia, the vascular elements of the tumor may become comparatively insignificant and there may be a predominance of fibrous tissue with sclerosis of the channels or masses of adventitial epitheloid cells between the spaces. If there is a predominance of the latter, the large cellular epitheloid histocytes, it is important that the tumor be carefully distinguished from the malignant angiosarcoma.

Rarely, there are certain of these tumors that are microscopically similar to the ordinary benign capillary or cavernous hemangioma and yet which metastasize and when they involve extensively the internal organs are the cause of death of the patient and thus are malignant. This group is not well defined. Much confusion has arisen in this regard and there are few authentic cases on record.

Corresponding to the relation of the metastasizing hemangioma to the vascular tumors, is the malignant angiosarcoma with regard to the tumors which show

primarily neoplasia of the adventitial tissue. This rare entity is a rapidly growing tumor which has been described by Foot as being "composed of immature 'blousy' endothelial cells that may form channels for lymph or blood or may grow in lawless masses containing unlined vascular spaces in which the vascular fluid may flow".

For the purpose of clarification we present the following chart based on Foot's classification.

Capillary hemangioma.......... Cavernous hemangioma.........	(minimal supporting stroma)
Metastasizing hemangioma......	(cavernous or capillary)
Sclerosing fibrous hemangioma.. Hemangioendothelioma..........	(periendothelial hyperplasia)
Angiosarcoma	
Arteriolar hemangioma.......... Cirsoid hemangioma.............	(aberrant plexiform vessels with complete supporting stroma)

CLINICAL DIAGNOSIS

Diagnosis is only occasionally difficult. Discoloration is usually present. Often the area is compressible and will reexpand after the involved part is occluded. Elkin and Cooper have pointed out "on expansion the patient may complain of a feeling of fullness, heaviness, or pain. The rapidity of filling following compression is dependent upon the size of the arterial components."

Lesions of the face are best examined, according to the recommendation of Elkin and Cooper, with the patient in a horizontal position and with the head depressed. The mass will be seen to become large if the jugular veins are occluded by pressure. To this we wish to add a further observation of Stephenson that in an infant a definite increase in size during and following a transfusion is a positive indication. We have noted that the application of a tourniquet and Esmarck bandage to an extremity will display hemangiomatous tissue not ordinarily discernible and is useful for indicating areas to be injected.

Lesions should be ausculated as well as palpated. A bruit will not be heard unless a good-sized arteriovenous communication is present. An excellent diagnostic aid is roentgen examination. The film may show multiple millet seed opacities which are small calcified palques within the vessel.

Following trauma or thrombosis of a major venous channel leading from the tumor, rapid enlargement may occur and the tumor may become painful. This finding is sometimes deceptive and particularly problematic in the parotid area where accurate diagnosis is important and the frequency of tumors of glandular tissue occasion diagnostic difficulty.

THERAPY

In the treatment of hemangioma we have limited ourselves to the use of surgical excision and the injection of sodium morrhuate. In one case with tongue in-

volvement radium seed were implanted. Carbon dioxide snow was evaluated in some of our earlier cases and discarded. We feel that in almost all types of hemangioma injection therapy is indicated and surgical excision is to be selected when there is no response to injection or where hemorrhage, malignant degeneration, or cirsoid aneurysm is present. Injection therapy is a particularly important method in those cases where surgical excision would demand the loss of a part such as a nose, ear, lip, or perhaps the exenteration of an orbit to effect a cure. In these instances a cure resulting from sodium morrhuate injection effects the desired cosmetic results with the additional advantage of having saved the part for function.

If the problem of saving a part does not exist, one is faced with the problem of satisfactory removal of the tumor as opposed to injection. If all things are equal and surgical excision with eradication is possible by means of one operation, it frequently is the best procedure to follow in order to expedite therapy in as much as eradication of the area by injection therapy could mean frequent trips to the office over a period of months. We feel that the decision should not be made without careful consideration of the tumor location, the availability of tissue for repair, ease of surgical excision, and the possibility of complete eradication by one surgical maneuver.

The technique of therapy is simple. The involved area is cleansed with alcohol and then with a 25 or 26 gauge needle attached to a tuberculin syringe the area is injected with from 1 minum. to 4 cc. of sodium morrhuate, the amount being determined by the clinical appearance and response at the time of infiltration. More recently we have had a tendency to use the smaller doses particularly in areas about the eye or lip or in a mucous membrane covered surface. At intervals of ten days to five weeks injections are repeated.

The injection of sodium morrhuate causes thrombosis with secondary sclerosis, atrophy and absorption of the vessels. To be effective it does not have to come in contact with the vessel lining.

Complications of injection are central necrosis and ulceration, and in one instance, diffuse thrombosis (case 3). Although an allergic reaction is to be anticipated, it has not occurred in our series. The fact that the injection of the substance into normal tissue does not cause painful necrosis is a satisfying aspect of this type of therapy.

We have treated 39 patients with injections, the youngest patient being six weeks of age, and the eldest 35 years.

Case I. B., the patient, was first seen 1/19/44 at the age of four months. She previously had received two radium treatments to the left side of the cheek which was involved with hemangioma. This tumor involved the greater part of the lower and upper eyelid, the soft tissue at the inner canthus of the eye, and on everting the lid was seen to be present in the palpebrum and scleral conjunctiva. The lateral wall of the nose and the cheek were also involved. Since this time the patient has received a total of 11 injections in the 3½ years that she has been under our care. We have injected directly into the conjunctiva but have not used more than 2 cc. at any one time due to the location of the lesion.

Case II. M., the patient, a four year old girl, was first seen by us on 3/6/47. At that time she was suffering from hemangioma of the right labia majora and periurethral tissues.

There had been a slight but gradual increase in size since birth. We decided again, because of location, to select injection therapy and in a period extending over 18 months made nine injections of about 2 cc., although on one occasion 3 cc. was instilled.

Case III. A white sixteen year old girl had noted a recent increase in the size of a hemangioma of her nose which had been present since birth. When first seen, the hemangioma measured 2 mm. in diameter. On 2/5/47 the patient received an injection of 3 minums, and one and a half months later (Mar. 26, 1947) the patient received an injection of 4 minums. Immediately, the patient felt giddy, had a sense of fullness localized over the forehead and in an area about 5 x 4 cms. were seen fine purplish blue spots distributed radially and resembling capillary thrombosis. Following this, the patient had considerable swelling which subsided gradually. She has received no injections since that time.

FIG. 1

FIG. 2

FIG. 1. *Case I.* Photograph of patient presenting extensive hemangioma involving the cheek, nose, upper and lower eyelid and soft tissue at the inner canthus of the eye. Eversion of the lid revealed extension into the palpebrum and scleral conjunctiva

FIG. 2 *Case I* Profile of the same patient showing bulky substance of the tumor

Case IV. J., a girl infant now under treatment, was first seen by us on 7/16/47 at six weeks of age. She had multiple hemangioma, two of which were of considerable size. One involved the upper and lower eyelid and the other large tumor was located on the right thorax. The orbital tumor did not permit the separation of the eyelids. We felt that the appearance of the lesion, the ulceration, and the history of rapid growth warranted a biopsy to assure us that we were justified in injection therapy. The biopsy report was hemangioma. The lesion of the left orbit has to date been injected on three occasions with an average of 2 cc. each injection. The other lesions have also responded to therapy.

Case V. P., a girl infant, age 3 months, came in suffering from a bluish oval tumor of the right eyelid. She was first seen 5/19/47 and injected with $1\frac{1}{2}$ minums. Again, on 6/30/47, she received 3 minums with resultant almost complete sclerosis.

Following the failure of the lesion to respond to injection therapy, we have selected surgical extirpation as the method of choice Other therapeutists have employed interstitial radiation, electro dissection or the insertion of steel wire electrodes under similar circumstances or in instances where surgical excision is inadvisable or incomplete Particularly in tumors of the parotid area or extending into the neck is radiation therapy to be preferred according to Elkin and Cooper, Byars, and Bailey and Kiskadden Gold seed containing 0 25 to 1 5 millicure, have been used by Byars, Kiskadden, McCarthy, Figi and

FIG 3

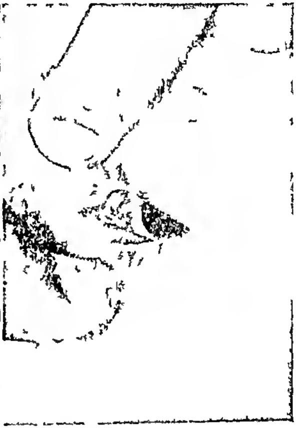

FIG 4

FIG 3 *Case I* Photograph showing patient one year later after seven injections into the substance of the tumor This tumor has not been completely sclerosed but definitely arrested and is in a state of regression

FIG 4 *Case I* The conjunctiva is exposed to show residual involvement and incomplete thrombosis of hemangiomatous tissue of the palpebrum and scleral conjunctiva

Watkins and others with considerable success We feel that the dangers of such therapy should be emphasized and because of the inherent dangers we have not used x ray, radium, or radon seed implants except in one case Alopecia, atrophy of breasts and genitalia, due to radiation of proximal areas, premature ossification of the long bones, and cancer of the lips and vulva, have been properly accredited by Watkins and McCarthy to radiation therapy in the treatment of hemangioma Moreover, radiation applied to hemangioma is prone to develop squamous cell carcinoma as a subsequent complication There is particular risk in using radiation in regions of the eye because of danger in subsequently

developing chronic ulceration of the cornea or adjacent structure, of effecting growth disturbance in this region and of particular risk is the possibility of developing radiation cataracts.

The following case illustrates an extensive tumor of the parotid area which presented a difficult clinical problem. In our series of three such similar cases complete surgical extirpation has resulted in destruction of the seventh nerve. We feel that once a definite diagnosis in such cases is established immediate

Fig. 5

Fig 6

Fig. 5. *Case II.* Extensive cavernous hemangioma involving right labia majora and surrounding tissues. Photograph of patient following three injections with good sclerosis.
Fig. 6. *Case II.* Appearance of labia majora approximately one year later after receiving seven injections.

active treatment is demanded. If the area is bluish in color, and if it increases in size on jugular compression or in response to rapid administration of intravenous solution, a therapeutic trial of sodium morrhuate may be warranted. If response is not promptly satisfactory, surgical intervention with adequate exposure of the tumor is indicated, and, if diagnosis is confirmed, a large quantity of sclerosing solution should be injected in the tumor thus exposed and later the tumor treated by injections administered in the usual manner. Failure of the tumor to regress promptly under injection therapy dictates immediate surgical excision.

Case VI. A two month old male infant was seen on 5/5/47 with a lesion of the right parotid area The parents had first noted the tumor when the patient was three weeks of

age. The swelling increased on crying. Prior to surgery the patient was transfused and a marked increase in the size of the tumor was apparent at this time. At the time of surgery, the lesion was found to be quito extensive. The parotid gland was exposed and in order to excise the mass, the seventh nerve was sacrificed. Following a satisfactory surgical postoperative course, the patient is well hut has the anticipated facial paralysis.

We have excised 56 hemangiomas from individuals from six weeks of age to 50 years. These have varied in size from 1 cm. to 16 x 38 cms. In 38 instances we were able to close by direct approximation with satisfactory results.

Fig. 7   Fig 8

Fig. 7. *Case III.* Photograph of patient with small capillary hemangioma involving the bridge of the nose.

Fig. 8 *Case III.* P[illegible] njection of 4 minims of sod[illegible] orehead [illegible] accom- [illegible] the tumor for a considerable distance.

At the present time we are treating two cases by the method of partial excision. In seven cases, because of the extent of the lesion, we were forced to use skin grafts to obtain skin covering following surgical extirpation. The following case history is of a patient requiring extensive skin grafting:

Case VII. A sixteen year old girl complaining of a birth mark of the left leg was seen by us on 10/2/46. The hemangioma extended from the sole of the foot on the medial side to the inguinal area and involved the anterior surface of the leg and thigh. Prior to coming to us she had been treated with x-ray with little alteration in the character of the lesion.

On five occasions during the first five months of observation, she received injections of sodium morrhuate, the largest of which was 4 cc. Following two of these injections there was ulceration and secondary infection. With regard to the ultimate control, we did not receive a satisfactory response from this method and because of the evidence of superficial changes characteristic of radiation, surgery was advised.

X-ray of the left leg and thigh prior to surgery revealed pheloblíths. On 4/9/47, the patient was admitted for surgery. The involved area from the ankle to the knee was excised and grafted with three dermatome drums of skin. Again, on 7/17/47, the patient was taken

FIG. 9 FIG. 10

FIG. 9. *Case IV*. Photograph of the orbital tumor of an infant six weeks of age who has multiple hemangioma. When first seen the lids could not be separated. There was a central area of necrosis. On biopsy the tumor was benign and injection therapy is being undertaken.

FIG. 10. *Case IV*. Appearance of infant following two injections with sodium morrhuate.

to surgery and the involved tissues of the thigh were excised. Skin coverage was not attempted at this time because the muscle and fascia were involved and it was felt that sclerosis would be encouraged by leaving the wound open and grafting it at a later date. On 7/24/47, two and a half dermatomes of skin were used to cover the granulating area. This took well and the patient was discharged. She has no limitation of the knee joint and walks unaided despite the excision of muscle tissue. The grafted area measures 16 x 38 cms. at the most extreme edges. The pathological diagnosis was "capillary hemangioma with a few areas of cavernous hemangioma."

The following case was particularly interesting because of the extent of involvement and the rapidly increasing cirsoid character of the lesion. Surgical intervention which did not permit complete extirpation because of extensive

bleeding resulted in the ligation of several large vessels with brought about cessation of the rapid progress and a considerable decrease in the size of the tumor. This patient is still under treatment.

Case VIII. Y., on 5/3/44, a three year old girl with a bluish discoloration and swelling at the base of the neck and supraclavicular region and extending downward and across the shoulder, and involving the outer aspect of the right arm, was seen in our office. Her mother stated that at birth the "birthmark" was the size of a pea and located on the side of her neck. She was admitted to Touro Infirmary and on 5/5/44 the varix of the arm was ligated. On 4/21/45 the patient was again hospitalized and at this time an extensive mass on the right side of the neck was extirpated. Several large vessels were ligated and

FIG. 11 FIG 12

FIG. 11. *Case V.* Infant with cavernous hemangioma of upper eyelid

FIG. 12. *Case V.* Complete thrombosis with regression of the tumor following two injections is shown in this photograph taken three months later.

the pathology was reported as: "dilated thick-walled veins (probably arteriovenous anastomosis)". Again on 5/25/46 the patient was taken to surgery and a partial excision of the mass of the right side of the neck was accomplished. At this time several large varix were excised and the diagnosis was: "cavernous hemangioma infiltrating fat, fibrous tissue, and muscle". Our last surgery was performed 5/25/47 because of increasing size and extent of involvement of the right arm. At this time a longitudinal incision was made in the mid-portion of the upper arm. Extensive bleeding was encountered and the incision was carried down to the bone in order to effect hemostasis which only was accomplished by the application of pressure bandage. Since this surgery there has been no apparent decrease in size.

Because of the rarity of metastasizing hemangiomas which on biopsy are microscopically benign but prove ultimately to be malignant, we wish to include

a case on which we were privileged to be consulted by Dr. Charles Donald, Jr. of Birmingham, Alabama.

Case IX. W., a boy, age 10, was seen by Dr. Donald on May 8, 1943 because of enlargement of his abdomen, anorexia, lassitude, and nausea. He was hospitalized because of palpable abdominal masses in the lower right quadrant and upper left, the latter being identified as spleen. His hemogram revealed no abnormalities. On 5/18/43 an exploratory laporatomy was performed with a biopsy of the liver and spleen which was reported to be "cavernous hemangioma, microscopically benign." Postoperatively he developed pneumonia, but following recovery was given a course of x-ray therapy. On 1/29/45, the patient

FIG. 13 FIG. 14

FIGS 13 AND 14. *Case VII.* Photograph of sixteen year old girl with extensive hemangioma involving anterior surface of the thigh and leg.

was readmitted with the complaint of pain in the abdomen and chest following trauma. He responded to transfusions and supportive therapy and was discharged 2/17/45. He died at home ten months later 12/19/45. Autopsy showed metastasizing cavernous hemangioma with involvement of the liver and spleen primarily but implants on the intestine, kidney, and metastasis to the retroperitoneal nodes. Microscopically, the diagnosis of benign cavernous hemangioma was substantiated.

And finally, we wish to present a case which at this time we feel is not amenable to any type of therapy, but which might have responded to radical therapy undertaken as soon as the lesion was apparent.

Case X. M. B. was first seen at the Mayo Clinic in 1919 and diagnosed neurofibroma of the right eyelid. At that time she received radium treatments. In June 1926 she had an

ulceration of the cornea and complete blindness therefore the eye was removed. The report of the pathology of the eye was lost by the doctor in Minot, North Dakota, so that it is unknown. The patient was seen by us 8/4/46 at that time being 32 years of age. On 9/5/46 she was operated and only a biopsy taken because of the excessive bleeding which was difficultly controlled. The microscopic diagnosis at that time was hemangioma.

Our experience with carbon dioxide snow therapy early persuaded us to give up this form of treatment as of little or no value. Because of the ill effects

FIG. 15

FIG. 16

FIG. 15. *Case VII.* Photograph of leg showing repair by means of half-thickness skin graft.

FIG. 16. *Case VII.* Appearance of the thigh and leg following complete extirpation of hemangioma with repair of the defect by skin graft.

previously mentioned we have not used x-ray or the direct application of radium or radon to surface lesions. This type therapy is not successful in lesions having well differentiated endothelium and it is also to be recognized that the radiosensitivity of the growth is in inverse proportion to the age of the patient. However, Byars, Figi, and others show excellent results from this therapy and feel that it is indicated if the lesion is of such size that surgery or cautery excision would be deforming. Watson and McCarthy feel that the method is to be reserved for those cases which do not respond to injection therapy. Pfahler, Byars, Kiskadden and Bailey emphasize the importance of proper filtration of the radium plaque by use of 0.5 mm. of platinum in order to utilize the gamma rays and protect the tissues against the caustic action of the beta rays. Pigment

injections as advocated orginally by Pauli and others will cause a certain amount of thrombosis and may be a useful method of treatment of the port-wine type

FIG. 17 FIG 18

FIG. 17. *Case VIII.* Photograph of patient with racemose hemangioma of right side of neck, supraclavicular and axillary area and extending into the arm and hand.
FIG. 18. *Case VIII.* Photograph of patient following last operation. Regression of the growth is apparent both above and below the site of surgical intervention in the upper arm.

FIG 19 FIG 20 FIG. 21

FIGS. 19, 20 AND 21. *Case X.* Photographs of a patient with hemangioma involving the tissues of the periorbital, cheek and temporal regions.

lesion which heretofore has best been treated by excision and skin shifting procedures or simply the application of covermark. The latter does not satisfy

the patient and is not acceptable to the laborer who has less time for beautification.

SUMMARY

We have presented 95 cases of hemangioma treated by the injection of sodium morrhuate and by surgical excision. The determinative factor in the selection of the type therapy has been discussed and illustrated.

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SURGICAL CORRECTION OF DEVELOPMENTAL DEFORMITIES OF THE MANDIBLE

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The first record of the use of a surgical procedure for correction of malrelation of the jaws dates back to 1848. At that time, Hullihen (10) performed a partial osteoplastic resection of the lower jaw for deformity due to scar tissue contracture from a burn. It has been only during the past fifty years, however, that much interest has been shown in the surgical correction of prognathic deformities of the mandible. In December, 1898, Blair (fig. 1) (1) successfully performed an operation, as suggested by Angle, for correction of a deformity of this type. He described the operation in 1906. The operation consisted of removal of a quadrilateral section of bone from the body of the mandible in the molar area bilaterally and repositioning of the anterior segment in normal relationship with the maxillary teeth. The bone fragments were held in position by means of interdental fixation until healing was complete. In 1898, Jaboulai (fig. 1) (11) described a resection of the condyle for the correction of prognathism. Since that time, Dufourmentel (5), has advocated this same treatment (fig. 1).

During the past fifty years, numerous articles have appeared in the medical and dental literature describing various techniques for correction of prognathism. When one considers the great number of operations proposed for correction of this deformity, and also the various operations in use today, it is obvious that there is lack of uniformity of thought in regard to this problem. It is also evident that there is no one operation without some undesirable features. The great disproportion between the relatively small number of operations being performed and the great number of people needing such treatment, would also indicate that there is no uniformly successful standardized method of surgical treatment for this deformity.

In order to promote some discussion and provoke some thought on this problem, it might be well at this time to review the various methods advised and to critically analyze the desirable and undesirable features of each procedure. Correction of the deformity and repositioning of the teeth may be accomplished either by osteotomy or osteectomy.

OSTEOTOMY

Osteotomy is accomplished by transverse division of the ramus of the mandible, and shifting of the body of the bone backwards, where it is held in position during the course of healing. This principle was first proposed by Blair (fig. 1) (2) and since has been a very popular procedure in the hands of many surgeons. Osteotomy may be performed by making a horizontal cut across the ramus of the man-

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dible between the mandibular sulcus and the angle of the mandible, by cutting through the neck of the condyle, or by making the cut through the gonial angle.

There are many very attractive features that recommend osteotomy over the technique of osteectomy. It is, today, the most popular of the operative pro-

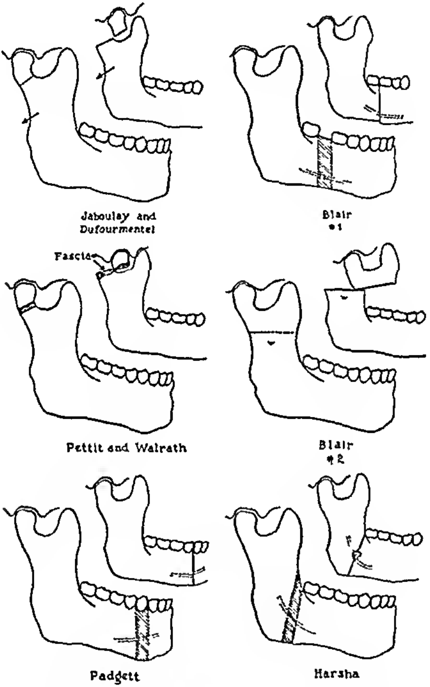

FIG. 1. Methods proposed for surgical correction of developmental prognathic deformities of the mandible.

cedures because it is simple to execute, avoids the possibility of injury to the inferior alveolar nerve, it does not entail sacrifice of useful bone, nor does it damage the mandibular arch or teeth. The operation also can be done without contamination with the oral cavity. There are, however, numerous disadvantages, very few of which have been given adequate mention in the literature.

Although excellent results have been obtained in the correction of prognathic deformity by the method of osteotomy, there are many disadvantages to the procedure and the possibility of failure is great. There is always the possibility of lack of control of the upper or proximal segment due to muscular action, with separation of the fragments and non-union at the site of the osteotomy. Attached to the ramus of the mandible are some of the strongest muscles of the body, and it is not possible to reposition the mandible any great distances without completely disrupting the line of pull and function of these muscles. When overriding of the fragments at the site of osteotomy occurs along with muscle spasm, there is shortening in the region of the ramus due to the strong upward pull of the muscles of mastication. With the molar teeth in occlusion, we have created a class I lever, which exerts great downward force in the anterior region of the mandible and may result in an open bite, which, in many cases, is worse than the original deformity. The force of this muscular action on the mandible may be so great that no appliance will prevent an open bite deformity in the anterior portion of the mouth. We have seen the teeth extruded from the mandible and maxilla when an attempt was made to overcome the force by intermaxillary fixation of the teeth.

Non-union at the osteotomy site is also a possible complication in this operation. The bone at the plane of the cut is very thin and is principally made up of cortical structure which may contribute to delay in healing. The additional factor of displacement of the segments in repositioning may so separate the fragments in severe cases that union is impossible. Wiring of the bone segments was proposed (4) as a means of overcoming this difficulty but the problem of muscle pull was still so objectionable that the technique has been abandoned in our clinics. We have had some brilliant results using this technique but other results have been so disappointing that we no longer feel justified in its use.

Osteotomy through the neck of the condyle has become a rather popular operation for correction of mandibular prognathism. This operation was proposed by Pettit and Walrath (fig. 1) in 1932. Their technique consisted of cutting through the neck of the condyle and interposing fascia to prevent union, in order to give a flail joint. The mandible was repositioned and held during the course of adjustment. This procedure at once, of course, suggests the undesirable feature of virtual destruction of function of both temporomandibular joints. This procedure would immediately disrupt function of the external pterygoid muscles and would seriously interfere with the normal movements of the mandible.

More recently the procedure of simple cutting through the neck of the condyle by blind passage of a gigli saw and repositioning of the mandible has been popularized by Kostecka (13) in Prague, and Shaeffer and Reiter in this country. Reiter has operated 23 cases successfully by this method without complication. The chief advantage of this operation, of course, is its simplicity of execution, but, it at once suggests the disadvantage of inability to control the proximal fragment, the possibility of injury to the seventh nerve and internal maxillary artery and the disadvantage of throwing the muscles of mastication

out of their normal alignment if the mandible is repositioned posteriorly any distance. Too well known surgeons have recently privately and unofficially described near fatal hemorrhages using this method and another mentioned severence of the facial nerve with total paralysis on the involved side. This procedure possibly would offer a satisfactory outcome in some of the less severe deformities, but would not be the procedure of choice in most instances.

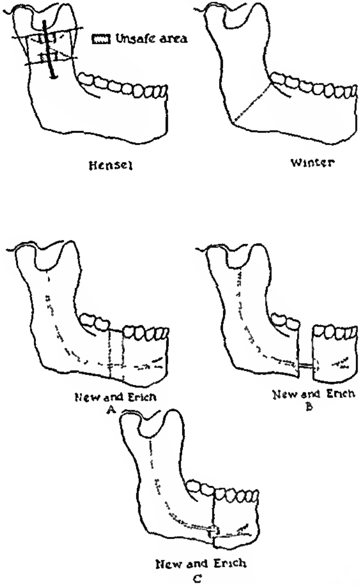

FIG. 2. Additional methods for correction of developmental prognathic deformities of the mandible.

Numerous other procedures have been described for sectioning of the mandible through the ramus. In cutting through the ramus, the most practical point of sectioning, as pointed out by Hensel, (fig. 2) (9) is in the area between the depth of the sigmoid notch and the mandibular sulcus. According to the studies of Hensel, the distance from the depth of the sigmoid notch to the lingula varies from $\frac{7}{16}$ to $\frac{10}{16}$ inches, with a relatively safe area of $\frac{3}{16}$ of an inch. A transverse cut too close to the sigmoid notch offers the possibility of separation of the coronoid from the condyloid process of the mandible and sectioning too close to the

apeutic and antibiotic agents. The necessity for opening into the oral cavity at the time of final sectioning of the bone has been overcome by a two stage procedure, introduced by Dingman (3), in 1944 (fig. 3).

OSTEOTOMY VERSUS OSTEECTOMY

The advocates of the principle of osteotomy, that is, sectioning through the ramus of the mandible, either through the condyle neck, through the ramus proper, or through the gonial angle, claim the following advantageous points in defense of the procedure: 1) Osteotomy affords the greatest possibility of avoiding the mandibular nerve and associated structures; 2) It is easy to execute; 3) It avoids the extraction of normal teeth and sacrifice of useful bony structure;

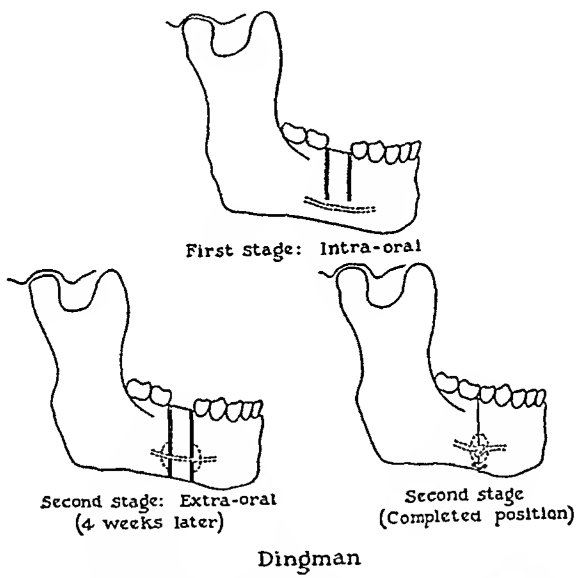

FIG. 3. Author's two-stage procedure for correction of prognathic deformities of the mandible.

and 4) also avoids the possibility of oral contamination. It has also been erroneously claimed that this procedure reduces to a minimum the muscle traction which tends to counteract the reduction.

In contrast to the numerous advantages claimed for this procedure, there are several obvious disadvantages. Parotid fistula, injury to the facial nerve, and serious hemorrhage from the internal maxillary artery have all been known to occur in operations for sectioning of the ramus of the mandible. A serious disadvantage and the one most liable to cause difficulty is the derangement of the muscles of mastication. The shifting of the insertions of these very delicately balanced muscles throws them out of harmony with each other and may very seriously interfere with their function. The possibility of over-riding of fragments, non-union, malunion, and open bite deformities must also be con-

sidered very serious disadvantages to osteotomy. The period of intermaxillary fixation is, of necessity, longer in osteotomy than in cases of osteectomy. The improvement of occlusal relationships depends upon repositioning the entire lower arch to the upper. There is no possibility of adjusting the relationship of anterior to posterior teeth as in osteectomy at the time of operation.

The advocates of the principle of osteectomy, or removal of a section of bone from the body of the mandible, also claim numerous advantages, namely: 1) the site of osteectomy is extremely accessible; 2) the section of bone can be removed from the mandible without interfering with the inferior alveolar nerve or its associated structures; 3) the procedure can be accomplished without contamination from the oral cavity; 4) the operation does not interfere with the muscles of mastication; 5) the fragments can be repositioned more accurately and satisfactorily; 6) and a dental splint fitted to the mandible will often hold the fragments in place after very short periods of intermaxillary fixation. It is possible to improve the relationship between teeth in the anterior part of the arch and those in the posterior by osteectomy. This is especially true in open bite cases where the anterior section is moved posteriorly and upward. The only objections to the procedure are that it necessitates the sacrifice of one or two teeth on each side of the mandible, if an edentulous space does not already exist. This procedure also necessitates the sacrifice of a section of mandibular bony structure. The fact that osteectomy offers almost completely uniformly successful results with a minimum of effort and only slight possibility of complications, would indicate that this is the method of preference in most cases.

AUTHOR'S METHOD

Since reporting, in 1944 (3), a two stage procedure for correction of mandibular prognathism, the author has had an opportunity to operate several cases of this type. The results have been uniformly successful and, in as much as some minor additional changes have been made which make the operation easier, opportunity is taken at this time to briefly review the technique of the procedure. The operation described is a modification of the method introduced by Harsha, in 1912, and again suggested by New and Erich (fig. 2), in 1941, by which a section of bone is removed from the body of the mandible without interfering with the inferior alveolar nerve and its associated structures. All of the methods described for sectioning through the body of the bone, previous to the description of the two stage procedure, have the disadvantage of compounding the wound intra-orally during the course of the operation. This is thought to be a point of minor consequence by many surgeons, but, nevertheless, the possibility of osteomyelitis due to oral contamination does exist and any method which might obviate this complication most certainly should be considered. This two stage procedure, as described, makes it possible to obviate many of the undesirable features of other proposed operations. The procedure consists of removal of a section of bone from the body of the mandible, without cutting the inferior alveolar nerve or compounding the wound intra-orally. Section through the body of the bone further is advantageous because the muscles of mastication

remain undisturbed, troublesome anesthesia is avoided, and the possibility of infection from oral contamination is eliminated. The exposure possible during the first stage procedure permits extreme accuracy in outlining the section of bone to be subsequently removed and very greatly reduces the operating time at the final stage. The technique, as described, has the disadvantage of sacrifice of normal tooth structure and bone at the operative site, but this disadvantage becomes minimal in the light of accomplished end results. Another theoretical disadvantage is disturbance of the temporomandibular joint incident to the slight medial rotation of the condyle head due to shortening of the transverse distance between the mandibular molar areas. The distance between the mandibular molar areas becomes slightly shorter when the anterior segment is moved posteriorly in contact with the proximal fragments. This has never become a clinical disadvantage, however, as none of our patients has complained of discomfort in the temporomandibular joints.

Correction of mesioclusion or prognathism is accomplished in two stages (fig. 3). Following a careful consideration of both the local and general conditions, the site of osteectomy is selected. The area to be used is determined by a detailed study of articulated casts. The site usually chosen is distal to the second premolar tooth in order to avoid injury to the mental nerve. The selection, however, may be influenced by existing edentulous areas in either the premolar or molar areas. It is possible but technically more difficult to remove the section of bone to include the mental foramen without injury to the nerve. This was done in one of our cases to avoid unnecessary extraction proximal to the edentulous bicuspid area. The ideal area is the first molar region, but in some instances where this is not large enough to permit adequate excision of bone, the second bicuspid or second molar area might also be used. In cases where the second molar area is already edentulous, it is unwise to extract normal first molar teeth to create a site for the osteectomy. The section of bone can be just as well removed from the second or third molar area, although the technical difficulties increase slightly distal to the first molar region. The width and shape of the section of bone to be removed is accurately predetermined by a careful study of articulated plaster casts and is dependent upon the degree of prognathism and the degree of opening or closing of the bite necessary to obtain optimal occlusal relationship. In most cases the bone sections to be removed on either side will not vary more than a few millimeters in size. In some instances lateral deviation may necessitate a wide section on the side opposite the direction of deviation and removal of a small section from the contralateral side (fig. 4). Removal of unequal sections permits rotation of the laterally deviated anterior segment into normal relationship with the maxillary arch.

In selecting the site of osteectomy and the amount of bone to be removed, the orthodontist should be consulted. In some cases where the maxillary arch is somewhat constricted and orthodontic treatment is contemplated after surgery on the mandible, it is unwise to move the mandible too far posteriorly. Surgery should be considered in most cases as an adjunct to orthodontic treatment and not as a complete and final corrective answer to the problem of malocclusion. These patients should all be advised about the probable necessity for orthodontic

FIG. 4 A–F

FIG. 4. Case No. 1. Application of principles of two-stage procedure for the correction of a prognathic deformity with cross bite relationship of the teeth.

treatment in order to bring the teeth into the most desirable occlusal relationship following surgical correction of the gross deformity. Orthodontic treatment after surgery is not often necessary, however.

From the standpoint of fixation, it is desirable to have sound teeth on both sides of the operative site in order to insure greater stability of the fragments. This is not necessary, however, as in some of our cases we have sectioned the bone proximal to the last tooth in the arch. Although the proximal segments of bone were edentulous, approximation was maintained adequately by direct wiring and inter-maxillary fixation anteriorly. In the event that it is necessary to extract teeth from the area selected for section of the bone, they should be extracted with a minimum of trauma and a maximum of retention of buccal and lingual alveolar bone. The first stage of the operation may be done at the time of removal of the teeth. If a molar is removed the cuts through the bone may be made through the buccal and lingual bone opposite the root socket and to the depth of the socket.

The first stage is a relatively minor procedure and the patient is treated under local anesthesia as an out-patient. If the area is edentulous, this consists of making an incision along the crest of the alveolar ridge and gingival margins of the adjacent teeth, and elevating the mucoperiosteum from the buccal and lingual surfaces in the immediate vicinity. If a tooth is removed at the same time, the mucoperiosteum is elevated from the buccal and lingual plates opposite the area of extraction. Using a bone drill, the bone is cut downward and transversely across the alveolar ridge. In order to avoid injury to the inferior alveolar nerve, a safe distance is maintained between the depth of the bone incision and the nerve. The incisions are made through the bone exactly to measurement as predetermined on the plaster casts and outline the block section representing the amount of bone ultimately to be removed. In order to facilitate identity of the first stage cuts at the time of the second stage, they should be carried well down on the lateral cortical plates at the first stage procedure but not into the medullary bone below the plane of the root apices. The bone is not removed at this time (fig. 5A). The soft tissue is returned to position and carefully sutured in place over the ridge. The patient gets very little reaction from this stage of the operation and is treated as an outpatient. Sutures are removed on the third or fourth day.

The soft tissue is permitted to heal entirely over the ridge in preparation for the final stage, which is done four to six weeks after the first stage procedure. During this interval period, the orthodontist is engaged in constructing suitable upper and lower appliances for maintaining position of the segments after sectioning. The appliances must be individually designed to fit the case at hand, and they must be sturdy enough to hold the teeth accurately in position during the course of healing. The appliances are attached to the teeth by bands cemented to the teeth in all four quadrants.

The appliance most satisfactory in our hands is the type that permits intermaxillary fixation by vertical rubber band traction, and horizontal fixation across the site of operation by the use of hook attachments on the teeth immedi-

ately adjacent to the osteectomy site. In some of our cases, it was obvious from a study of the casts previous to the operation that some of the teeth in the lower arch would not be in contact with the opposing upper teeth. In these cases we have found it expedient to construct simple occlusal splints made of acrylic. It

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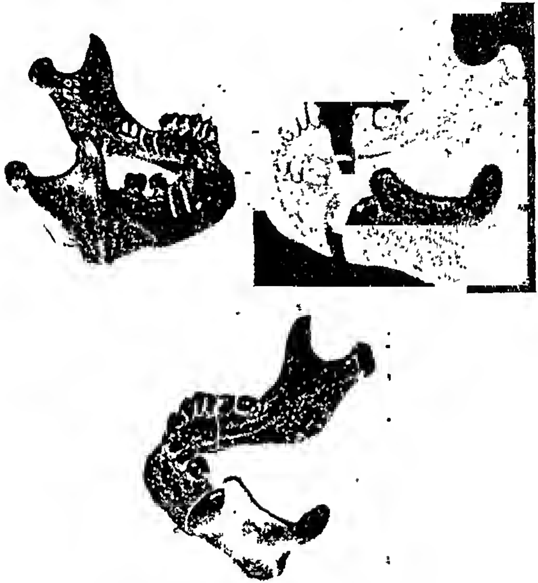


C

FIG. 5A. At the first stage, a section of predetermined width is outlined through the alveolar portion of the bone and is carried down to the plane of the apices of the teeth. The

ne is removed. Medullary
the fragments without injury to the nerve.

FIG. 5C. The lower border of the bone is approximated and held in position by use of stainless steel or tantalum wire.

is possible by this method to insure accurate positioning of the segments and to prevent elongation of teeth not in direct occlusion.

In our experience, we have found it more satisfactory in favorable cases to resort to occlusal splints, where a good immediate postoperative occlusion does not

seem to be probable, rather than to submit the patient to preoperative orthodontic treatment (fig. 6). The mandible is placed in the optimum position from which orthodontic treatment can be started by resorting to the use of such splints rather than to submit the patient to a preoperative and later postoperative course of orthodontic treatment. In a few cases, preoperative orthodontic treatment has seemed desirable.

After the necessary appliances have been constructed, the patient is hospitalized and prepared for the second stage of the surgery. Most of these patients can be operated under local anesthesia, which is preferable when possible. When properly premedicated, the patient can be carried under local anesthesia without difficulty. If it is necessary to use a general anesthetic, endotracheal

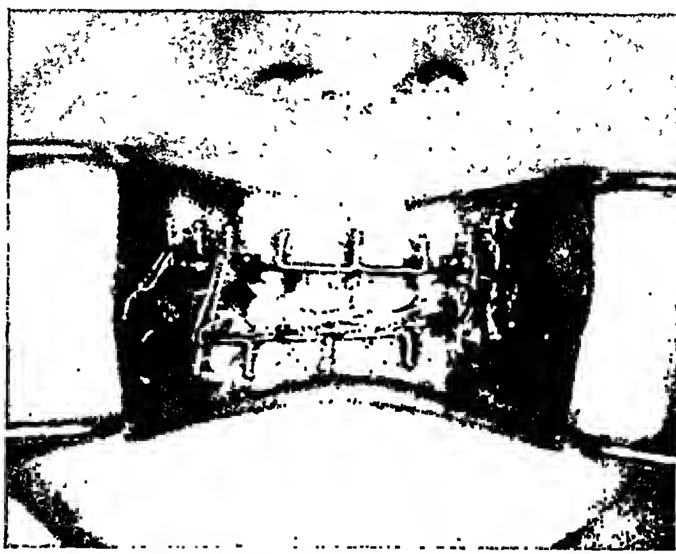


FIG. 6. Sturdy orthodontic appliances should be constructed to hold the teeth in occlusion during the course of healing. Intermaxillary rubber bands at first are used. These later are replaced by fine stainless steel wire. A clear acrylic splint is used here to supplement the occlusion in edentulous areas and in areas where the teeth are not long enough to come into occlusal contact.

anesthesia by way of nasal tube is preferable, and the teeth should not be placed in occlusion by intermaxillary fixation postoperatively until the patient has completely reacted from the effects of the anesthetic.

Before preparing the operative field, the proposed site of incision is marked out on the skin with methylene blue in order to avoid confusion after the patient is draped and the operation is in progress. Incisions are made bilaterally parallel and 1 cm. below the inferior border of the mandible in the selected area. Careful dissection should be done to avoid the mandibular branch of the facial nerve. Through this incision the lower border of the body of the bone is exposed. By carefully retracting the periosteum medially and laterally a slight amount, the cuts in the bone from the previous intra-oral stage are readily identified. By

the use of bone drills, these cuts are extended through the cortical plate of bone down to the lower border of the mandible. A horizontal cut through the cortical plate on the lateral surface about 1 cm. above the inferior border and between the two vertical cuts permits the insertion of a small chisel. A twisting motion fractures off the lower border of the bone exposing the nerve. Great care is exercised in order to avoid the mandibular nerve, which is carefully exposed by removal of the surrounding medullary bone (fig. 5B). After identification of the nerve and before the bone is completely excised, holes are drilled with a small bone drill from the buccal to the lingual just above the inferior border of the bone on both sides of the osteotomy site. These small holes provide pathways for passage of 22 gauge stainless steel or tantalum wire, which is used to approximate the bone fragments. The medullary portion of the bone is then countersunk or hollowed out in the immediate vicinity of the nerve to permit a resting place for the excess of nerve when the bone fragments are approximated. After excision of the bone up to the nerve, it is quite simple to remove the entire block of bone above the nerve without getting into the oral cavity. This is possible because the bone has not yet healed following the first stage. In all cases of osteotomy where the section of bone is removed distal to the last tooth in the dental arch, it is necessary to accurately fix the fragments by direct wiring. The bone should be wired securely to prevent slipping or upward riding of the posterior fragment due to action of the closing muscles of mastication. The wires are twisted tightly and cut short (fig. 5C). It is generally unnecessary to remove this wire. The patient, however, should be advised about the possibility of a foreign body reaction about the wire, which might necessitate its removal. Steffenson (19) has suggested the use of heavy catgut for fixation of the bone fragments at the lower border. This might be adequate if supplemented by sturdy intra-oral appliances for fixation of the bone segments except in edentulous posterior fragments.

In those cases where adequate orthodontic appliances have been constructed and the teeth can be brought into occlusion and held by intermaxillary fixation, it might be unnecessary to approximate the bone by direct wiring. This can be determined in the individual case. The wound is closed in layers with appropriate sutures for deep tissue and skin margin approximation and a small Penrose drain is left in place in the wound for twenty-four hours.

In our experience we have found intermaxillary rubber band fixation most satisfactory. The constant traction permits the teeth to come into the optimal occlusal relationship within a few days. At the end of two weeks the rubber bands are replaced by fine stainless steel wires to facilitate oral hygiene.

In order to avoid respiratory difficulties, New and Erich (16) advised a waiting period of twenty-four hours after surgery before bringing the teeth into occlusion. This period permits the patient to completely react from the anesthetic and to recover the protective respiratory reflexes before adding the additional difficulty of crowding a large tongue into a reduced oral space. If the operation is done under local anesthesia, the waiting period is unnecessary, providing the patient is awake and having normal reactions. This waiting period, before fixing the

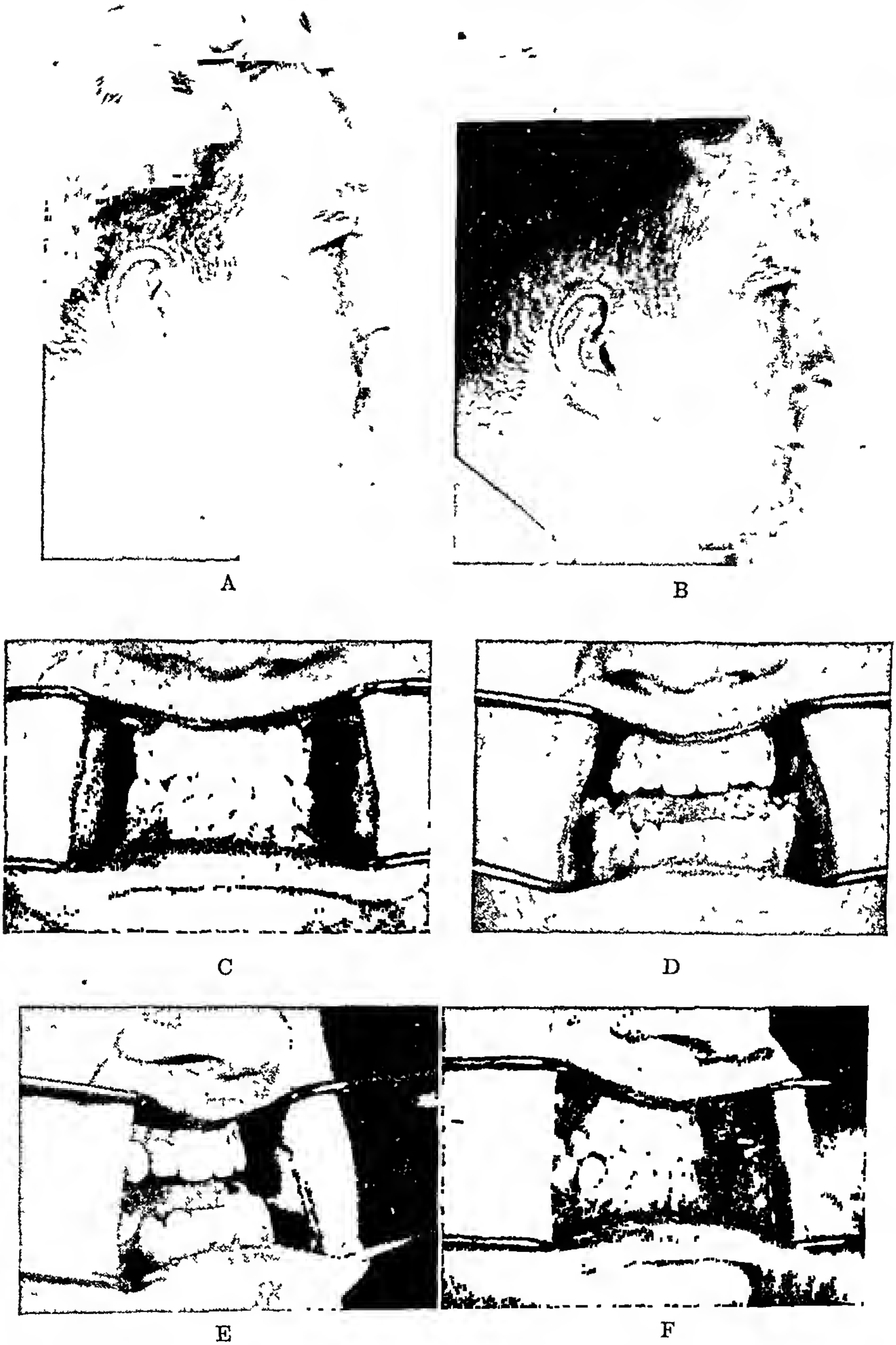


FIG. 7 Case No 2 Prognathic open bite deformity corrected by two-stage osteotomy

teeth in occlusion is especially necessary under general anesthesia when there is unusual enlargement of the tongue with the necessity of removal of a large amount of bone on both sides.

All of these patients should have special nursing care for the first twenty-four hour period. The patient is afforded the general and special care usually given to jaw fracture patients. The usual period of fixation is about eight weeks, although this might be decreased somewhat by using a sturdy orthodontic appliance to approximate the sections of bone.

A temporary anesthesia of the lower lip is noted in an occasional case. This is probably due to manipulation and edema of the nerve. The duration is short and in most instances sensation returns in two or three weeks (fig. 7. Case 2).

Heredity as an etiological factor in the production of prognathic deformities has received very little, if any, consideration. A 40 year old man, in our series, who had surgical correction of prognathism, has a 13 year old son with a similar deformity. One of our female patients recently operated has a sister who has an identical deformity. Her mother and maternal aunt also have prognathic anomalies and her maternal grandfather was said to have had a very prominent lower jaw.

RETRUSION DEFORMITIES OF THE MANDIBLE

Retrusion deformities in which the mandibular teeth are within the normal limits of occlusion with the maxillary teeth may be satisfactorily corrected by bone or cartilage implants to the anterior surface of the mandible. In marked retrusion deformities with malocclusion, implants of this kind fall short of producing the ideal result. The occlusion remains the same and the flexion crease of the lower lip becomes accentuated due to advance of tha skin at the inferior border and persistent adherence of the tissues of the labial vestibule to the anterior surface of the bone. There is no provision for supplemental support of the lower lip and it appears to be receded in most cases.

A procedure designed to advance the bone in order to improve the occlusal relationships as well as the contour of the chin seems advisable in certain deformities. To get the maximum in function as well as esthetics it may be necessary to combine a bone advancing procedure with a cartilage or bone implant to the symphysis.

We have used the operation of cutting through the ascending ramus between the mandibular notch and inferior alveolar foramen with a Gigli saw after the method of Blair. The body of the mandible was advanced and the teeth fixed in occlusion until healing was complete. The results in these cases were not entirely satisfactory. The objections to this procedure are the same as those to the osteotomy through the ramus for correction of protrusive type deformities. Because of certain disappointments a procedure was devised to overcome the disadvantages of the ramus operation.

The author has employed a two stage operative procedure for correction of retrusion deformities of the mandible in two cases. The operation is done through the body of the mandible and is accomplished in such a way that the

inferior alveolar nerve and its associated structures are not destroyed. The operation being done through the body of the mandible offers the distinct advantage over operations done through the ramus of non-interference with the muscles of mastication.

The first stage is done as an out-patient procedure under local anesthesia after a careful study of articulated casts and x-rays of the mandible. The mucoperiosteum is carefully laid back from the buccal and lingual surfaces of the mandible at the site of operation and a single vertical cut is made from buccal to lingual through the alveolar portion of the bone down to the plane of the

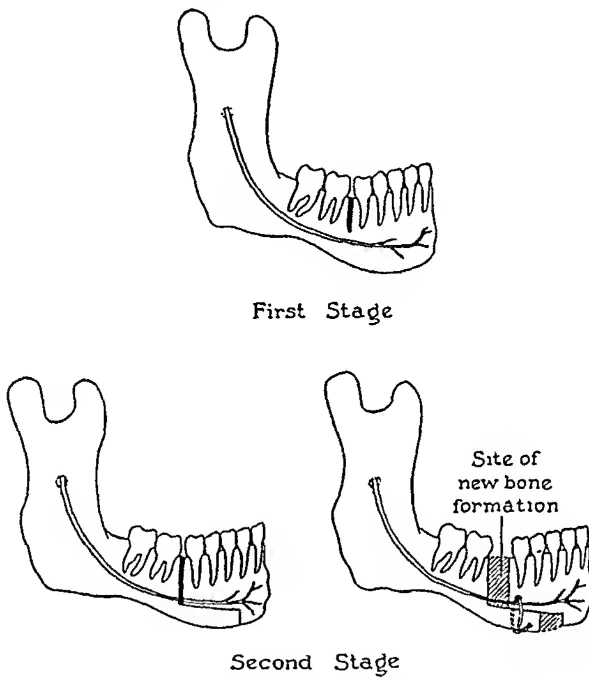


FIG. 8. Author's method of correcting retrusion deformities of the mandible

apical ends of the teeth. Care is taken to avoid injury to the inferior alveolar canal structures. This procedure is carried out bilaterally and the mucous membrane replaced over the bone and sutured in position (fig. 8).

During the course of intraoral healing adequate orthodontic splints are constructed and are carefully cemented to all of the available teeth in the maxillary and mandibular arch. This appliance is similar to the appliance used for fixation of prognathic cases. After a period of two or three weeks the patient is admitted to the hospital and is prepared for the second stage operation. After adequate premedication, the patient is anesthetized with a local anesthetic agent and an incision is made in the skin bilaterally parallel and one cm. below the inferior border of the mandible in the region selected for sectioning of the bone.

The inferior border of the mandible is exposed and the first stage cut is identified on its lateral surface. The mucoperiosteum is elevated very generously on the lateral and medial surfaces of the bone. Using a five-sixteenths inch steel circular saw on a dental mandrel, a vertical cut is made directly upward from the lower

Fig. 9 Case No 3. A retrusion deformity with disturbance of harmony of the facial features corrected by two-stage operation on the mandible. Otoplasty and rhinoplasty give additional improvement

border of the mandible at least 2 5 cm. anterior to the vertical first stage cut. The upper limit of the cut is below the level of the nerve. The saw is then turned so that the horizontal cut can be made from the anterior vertical saw cut posteriorly. This also is below the level of the nerve and is carried posteriorly as

far as the vertical extension of the first stage cut. Then using a very small bone drill, the cortical plate of bone on the lateral and medial surface of the mandible is cut to connect the first stage cut with the horizontal saw cut. A thin osteotome is then inserted in the horizontal cut and by gently twisting this instrument, the medullary portion of the bone surrounding the nerve is fractured (fig. 8). The anterior segment of bone is then advanced anteriorly where it is

E F

G

Fig. 9. Case No. 3

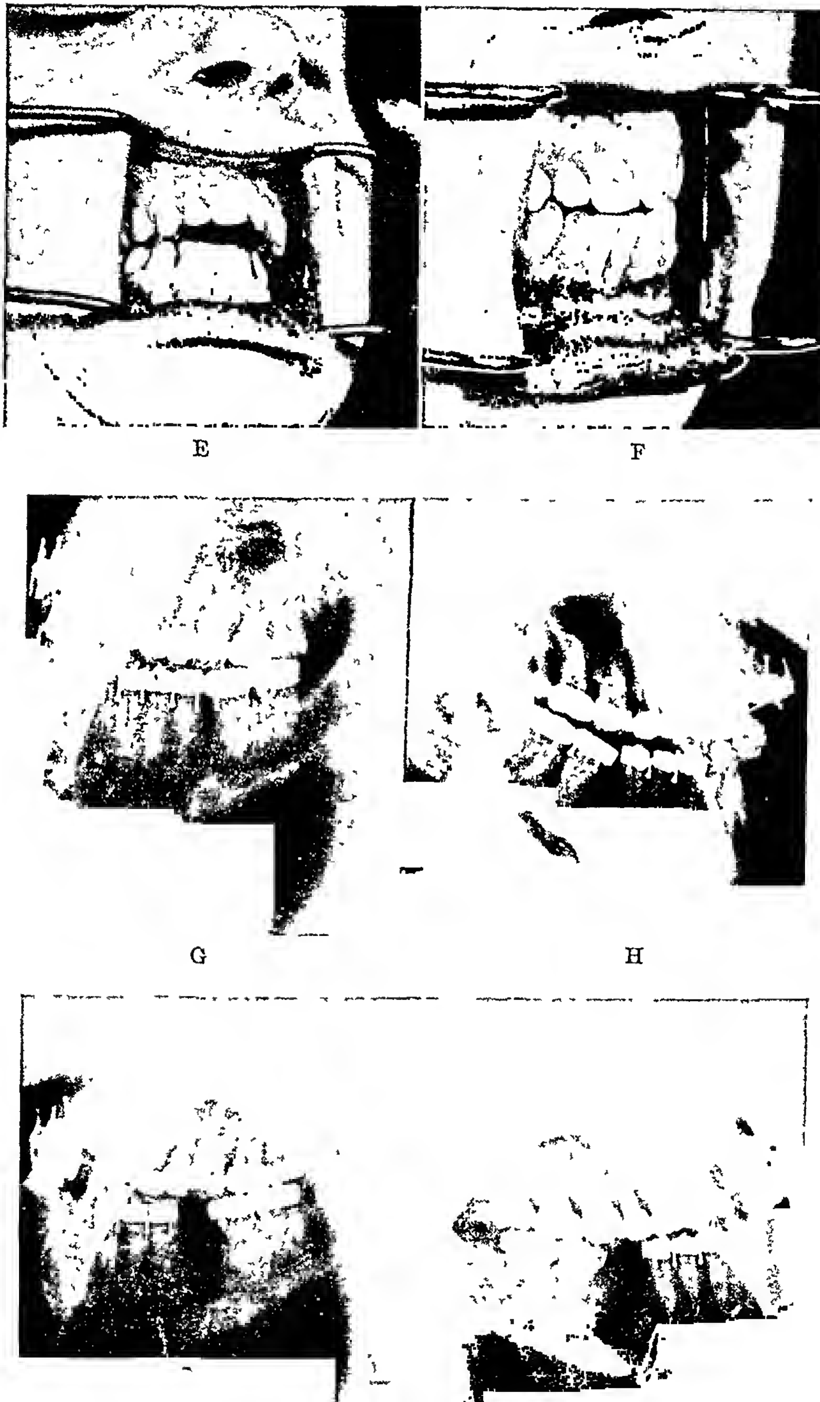
fixed in position with the maxillary teeth and held by means of wiring or intermaxillary fixation between the orthodontic appliances. A drill hole is then placed in the anterior segment from the lateral to the medial surface in such a way that the nerve is avoided. The wire is passed through this and is brought around the lower border of the mandible where it engages the posterior segment and is kept from slipping by engaging it in a small transverse notch made with the bone drill in the lower border. The wire is twisted and fixed firmly in position (fig. 8). In both of the cases done by the author, it was possible to advance the

A B

C D

Fig 10 Case No 4 Micrognathic deformity corrected by two stage advancing procedure on the mandible G & H show x rays after the first stage procedure I & J immediate postoperative x rays K & L x rays six months postoperative

anterior segment 1 cm without tearing the nerve The wound was then closed in layers and a penrose drain was inserted bilaterally This drain was removed after 24 hours Of the four operative sites in the two patients operated, the



E F G H I J

Fig. 10. Case No. 4

wound was compounded intra-orally in only one. This was not considered a serious complication, however, and no delay in healing or infection ensued. In both of these patients temporary anesthesia resulted. In one there was complete recovery in three weeks and in the other in four weeks sensation had returned to the lower lip (*figs.* 9 *and* 10. *Cases* 3 *and* 4).

This operative procedure might easily be modified to correct unilateral retrusion deformities as seen in ankylosis.

K L

FIG 10. Case No 4

CONCLUSION

1. Surgical correction of prognathic defects of the mandible has a greater possibility of success if operated through the body of the mandible rather than through the ramus of the mandible.

2. The two stage procedure of osteectomy eliminates almost all of the undesirable features in the surgical correction of prognathic deformity.

3. Heredity as a possible etiological factor in prognathic deformities of the mandible must be considered.

4. Retrusive or micrognathic deformities can be successfully treated by a two stage operative procedure on the body of the mandible. A new method is presented.

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LANGERS LINES AND FACIAL SCARS*

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Illustrations of Langers Lines as originally pictured in 1886 can be found in every textbook on Plastic Surgery. Just as Galen's anatomy of animals served for centuries as the anatomical comprehension of man's organs during the dark ages, so has Langer's diagrams and explanations derived from cadavers served these many decades. It is important to understand how Langer studied his skin lines Sticking pins in cadavers, he was able to discern lines which consistently ran in certain directions. He noted that many face and body skin lines in living beings coincided with his lines of pull. He was thus able to make up composite charts for the entire body.

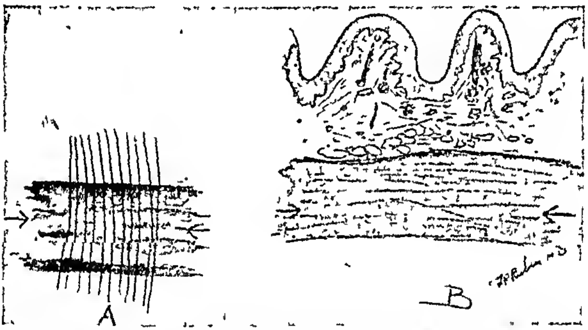

FIG. I. Diagramatic illustrations of skin lines caused by right angle muscle pull
a) Muscle is designated by arrows which also show direction of contracture. Lines are formed when skin adherent to muscle is bunched up like an accordian by muscle contracture. These lines are at right angles to muscle pull.
b) A cross section of skin and muscle showing the accordian pleats in the skin.

Later, it was found that incisions made in the direction of Langers Lines, resulted in a minimal scar. If the incisions were made across Langers Lines, the scars were heavier and wider. It was concluded that all planned incisions should be in the direction of these lines The explanation given was that the muscle ran in the same direction as the lines, avoiding tension at the wound edge, and that finer scars were the result This concept has been accepted to this day, and has been repeated over and over in the literature.

* Read before the American College of Surgeons, Kings County Hospital, Brooklyn, N. Y. [illegible]

[1] [illegible] County Hospital, Brooklyn, N. Y., [illegible]

We examined one hundred faces for facial skin lines. The studies were conducted by means of a police device, newly discovered.[2] A colorless chemical was impregnated on a cylindrical felt pad. The pad was pressed against the

FIG. II. Composite diagram of facial lines compared with facial muscles. These lines are created by the resultant contraction of the underlying muscle. This chart will vary for individuals. Variation is due to different muscle pull intensity.

face, coating it with a very thin layer of chemical. The tops of the skin ridges were thus coated, leaving valleys of dry skin. A sensitized paper was then laid over the face, pressed lightly and removed. The sensitized paper, hitting all elevated skin ridges, showed the facial lines.

[2] Manufactured by Mr. John Dondero of Faurot & Company, New York City, New York.

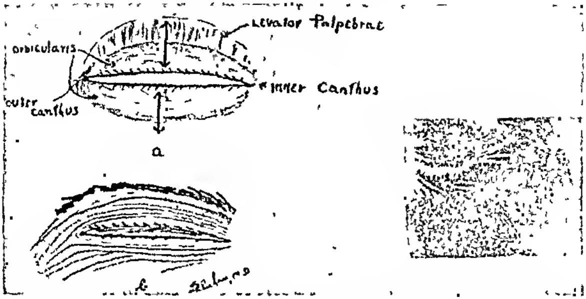

FIG. III. a) Diagram of the muscles about the eyelids The levator pulls the lid up (note arrows) causing the skin to fold longitudinally The orbicularis is attached to the

the lower lid.

Note the radiating lines from the outer canthus and

FIG. IV. These illustrations demonstrate the individual cheek variation of lines. These are two general classifications present. One type is the uplifting line pattern (happy type) and the other is the downward type (sad type).
a) It is noted all lines sweep down.

Analyses of the anatomical skin line structure of the different faces showed definite trends, at times similar, at other times at variance to Langers Lines. We found that the skin lines followed a definite pattern; being at right angles to

the resultant pull of the underlying muscles. Since the skin is attached to the muscles by fascia, it was thrown into accordian like folds or lines always at right angles to the muscle direction (see fig. I).

Examination of portions of the face illustrate the point.

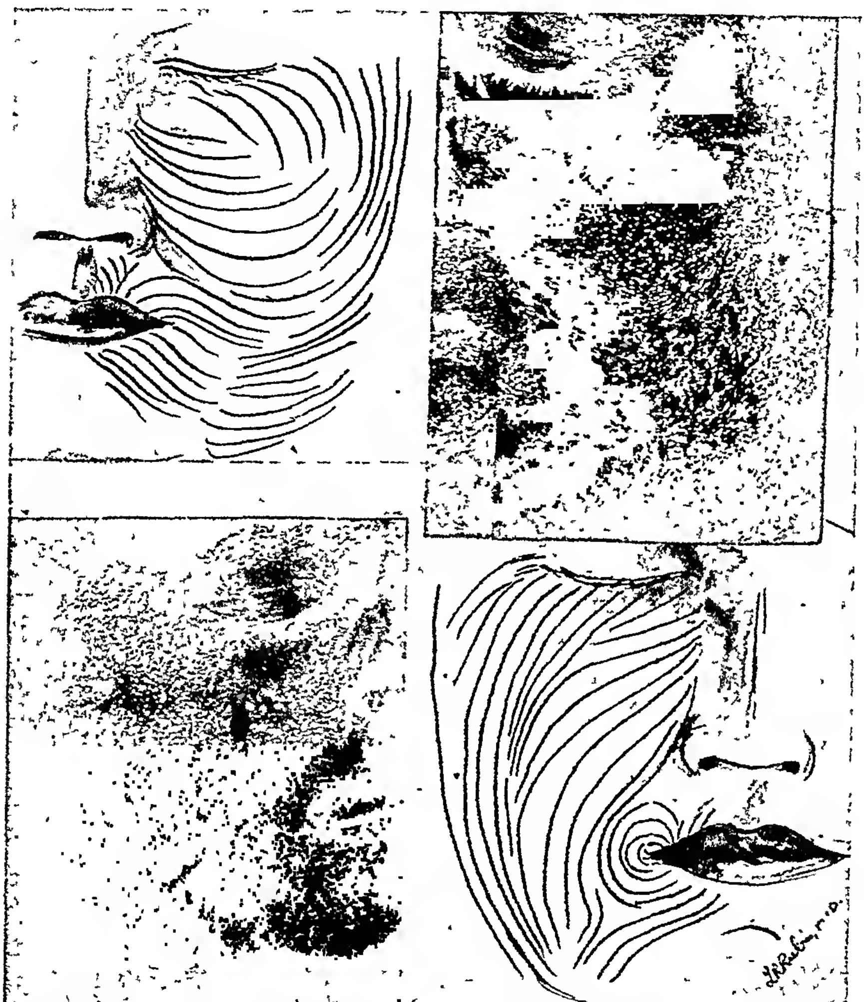

FIG. V. Lines about the upper lip fall into two general classifications. The important thing to remember is that all lines diverge from the midline.
a) The lines run divergent from the midline into the nasolabial fold.
b) The lines follow the described pattern. It is interesting to note how often the line pattern merges with and even crosses the nasolabial folds.

FOREHEAD

The lines shown were in accordance with Langers. They were horizontal, at right angles to the pull of the frontals. The midline area over the nose varied depending upon the superciliary corrugator in individuals which pulled horizon-

tally, bringing the eyebrows to the midline. The skin was therefore wrinkled vertically (fig. II).

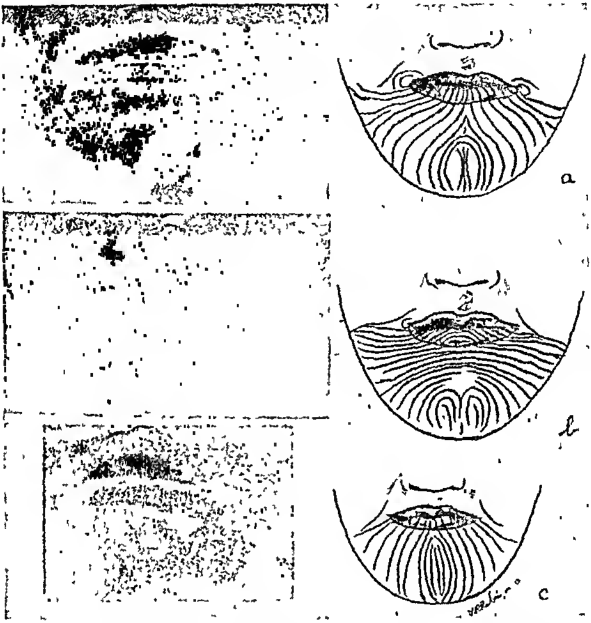

Fig. VI. The lower lip lines fall into two main classes
[illegible] then obliquely.
[illegible] Both groups are about
[illegible] line cleavage. Compare
[illegible] to form a figure M.

EYELIDS

The orbicularis oculi is a horizontal muscle held by bony attachments at the inner and outer canthus. The levator palpebrae arises from the supraorbital fastened into the tarsal plates. Contraction of the levator pulled the lid up. The orbicularis, held at two points horizontally, contracted to raise the lower lid and tightly shut the upper, forming horizontal lines against the resultant vertical pull. Langers Lines coincide with the anatomical muscle pull and with our face prints (fig. IIIa and b). Since the orbicularis formed a modified purse-string, the

lines of the lower lid tended to radiate from the lateral canthus, "Crows Feet" being formed by oblique lines radiating down the cheek; while at the inner canthus the lines curved on to the side of the nose horizontally.

FIG. VII. Preoperative photograph of a patient with squamous cell carcinoma of lower lip. Four years previously, patient had had a similar lesion on left side of lower lip which was removed by usual "V" incision. Since there was some palpable lymph nodes, patient had a bi-lateral upper neck lymph gland resection. Six months previous to this photograph, patient noticed a recurrence of papule on opposite side of lower lip which grew to the size of ¾ cms. in diameter. Upon decision to remove another wedge portion of the lip, surgery was performed using the incision as shown in the photograph. These lines were mapped by making a facial print and then noting the lines which would leave the best cosmetic scar.

a) demonstrates the lesion with the dotted lines of the projected incision.
b) shows the former incision.

MOUTH

The orbicularis oris, running around the mouth circularly, has no direct bony attachment to any facial bone. When the obicularis contracts, it throws the skin into folds resembling a purse-string. The exact lines vary with individuals, the variance being produced by the attaching muscles to the obicularis. Two

general types of folds about the mouth are shown in fig. IV. These lines are different from those described by Langer and certaily should be studied before lip surgery is contemplated.

Fig. VIII. F [illegible] month after excision according to skin lines. Th[illegible] the lower lip. [illegible] in (b) the old scar made four years ago cutting across the skin lines.

THE CHEEKS AND NASOLABIAL FOLDS

The nasolabial folds are caused by fascial attachment of the skin to deep muscle structures which range from the malar prominence down to the orbicularis. In fig. II the muscles and their directions are shown. Again note the skin lines at right angles to muscle pull. Examination of fig. V shows the cheek lines of two different types: one curving up and out (Happy type) the other out anddown (Sad type). Faces usually fall into one or other general type. Within this classification lines can vary still further. The individual factor makes it imperative to study each case.

NOSE

The greatest pull of the nasal muscle, the procerus nasalis, is vertically. Therefore the lines are horizontal (see fig. II).

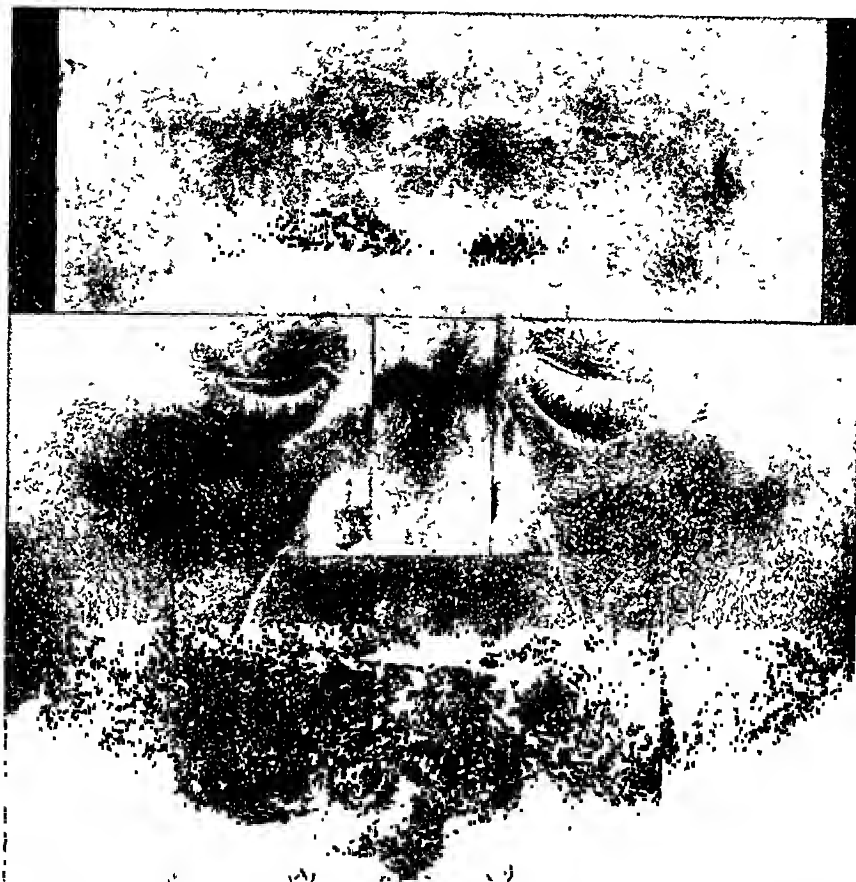

FIG. IX. Postoperative composite face print of the patient shown in figures VII and VIII. In (a) note scar cutting across the skin lines and in (b) note the minimal scarring of the incision which is curving to conform with skin lines.

CHIN

In midline, the skin is vertical. The lines radiate laterally from the midline of the lower lip, forming an archway over the mental protuberance and coming to meet horizontally under the chin. Study of fig. VI describes some variations.

NECK

Here the platysma and neck muscles all tend to shorten and lengthen the neck, causing the neck skin to fold in horizontal directions as expected.

DISCUSSION

The importance of skin lines has been emphasized for obtaining fine linear scars. Understandably, it has been pointed out that an elective incision in direction with the lines would heal with little scar. Heretofore, the explanation was two-fold: a scar parallel to the lines would be inconspicuous because it resembled a line. The other explanation was the misunderstood thought that Langers Lines ran in the *same direction* as the muscles, avoiding pull on the wound edges. The first explanation holds, but the second does not. Actually, the muscle pull tends to separate the wound edges, widening the scar. This fact must be understood if cosmetic surgery is a prime factor. Since the pull of muscle tends to widen the scars, is it advisable to make incisions in skin lines? The answer is yes, since having a scar simulating another skin line is of greater importance that the effects of muscle pull. A scar against skin lines stands out prominently. Knowing the danger of muscle pull the surgeon can take measures to overcome it by very careful suturing and postoperative care. Briefly outlined, the important things to remember in obtaining a fine scar are:

a) the suturing of all deep tissue in layers.

b) placing superficial subcutaneous sutures to take all tension off skin edges.

c) putting the finest sutures very closely together in the epidermis and removing them no sooner than three days. Since active healing is first starting at that time, the wound edge should be held by collodion strips (fine mesh gauze fastened by collodion across the wound edge). These strips should be applied and reapplied for at least two weeks, preferably three.

d) constant care to have anatomical parts at rest to avoid muscle pull.

CONCLUSION

1. The use of body and face prints have disclosed skin lines to be at right angles to muscle pull, resembling an accordian.

2. There is an individual variance of skin lines. They can be carefully observed by bunching the skin or better still by the simple apparatus used to make face prints.

3. Since skin lines are at right angles to muscle pull, elective surgical incisions must be carefully sutured and extreme postoperative care must be executed if a cosmetic scar is desired.

4. It is advisable to make incisions in direction with skin lines because such a scar would simulate a skin line.

5. The concept of Langers Lines as referable to its explanation, direction or anatomy is not accurate and should be discarded in light of this present work.

THE SURGICAL TREATMENT OF RECURRENT CARCINOMA OF THE BREAST AND CHEST WALL

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Approximately fifty years ago Halsted (1) and Meyer (4) described the standard procedure for radical mastectomy. While this operation is no longer the sole method of treating mammary cancer, for it is now frequently supplemented by irradiation, it is still the major means to combat the disease. This procedure accounts for the largest percentage of five-year survivals. The operation attempts to remove in one mass all of the structures which are liable to immediate invasion by the tumor. Because of the assumption that spread of the disease from its original focus proceeds by continuous permeation in all directions, a wide *en bloc* excision of the structures surrounding the primary tumor is attempted, and any separation or tearing of tissues within the operative field, which might result in structures invaded by the tumor being left behind, must be scrupulously avoided. Major factors influencing the probability of cure or recurrence are the localization and extent of the original lesion and the type of incision and procedure employed in the initial operation for mastectomy.

Numerous modifications of the original Halsted (2) operation have been made by different operators independently or inspired by Halsted's work. Time and experience, however, have led the majority of surgeons to a fuller appreciation of Halsted's (1–3) basic principles and methods. In using the elliptical incision which parallels the anterior axillary fold, the operator may follow either the Halsted or the Handley technique. That of Halsted, which frequently necessitates grafting, requires the removal of a wide margin of skin around the growth. The Handley technique involves the removal of less skin, but more extensive undermining of the flaps in order to secure primary closure. Stewart (5) employs transverse elliptical incisions, which may permit the removal of large amounts of skin and primary closure without grafting.

Halsted's original basis for the operation was empirical and antedated Handley's theory of lymphatic permeation by cancer cells. However, Halsted's experience with the localization of recurrences and metastatic foci following less extensive types of mastectomy is ample reason to attempt the widest possible excision. It is true that in some cases the extension of the cancer occurs by way of the blood stream and that tumor emboli may result in distant metastases even though microscopic examination of the specimen following radical mastectomy fails to show involvement of the axillary lymph nodes and neighboring tissues. Nevertheless, the operation originally conceived by Halsted and Meyer remains the standard procedure for radical mastectomy since it is based on sound surgical

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and pathological principles and is applicable to the majority of cases in which clinical evidence fails to indicate that the disease has already passed beyond the scope of operability. The proximity of the cancer to vital structures and its extent at the time of operation greatly influence the success of treatment.

Geschickter (6) found that the five-year survival rate by surgery in operable cancer approximates 70 per cent for cases without axillary involvement, and 25 per cent for cases with axillary metastases. The two groups are about equal in size. The combined curability averages about 47 per cent. Adair (7) found that the five-year survival rate following radical mastectomy in the operable group was 45 per cent and only 18 per cent in a similar group treated by irradiation alone. Lewis and Rienhoff (8) found that local recurrence takes place in approximately 35 per cent of the cases subjected to radical mastectomy. Similar figures were reported by White (9). While the number of cases with recurrent nodules may possibly be diminished by a more rigid selection of patients for operation, the figure remains high (6). Even though one patient out of every three upon whom a radical mastectomy has been performed will return with a local recurrence, *few operations have been described for the extirpation of these recurrent lesions.* Because of this fact the present study was undertaken.

LOCAL RECURRENCE

The distinction between recurrent and metastatic cancer is seemingly an arbitrary one. The *recurrent* lesions are those which appear in areas which are accessible to operation. The metastatic ones appear in distant regions or organs. It has been found (6) that recurrence is seen most frequently in the skin and subcutaneous tissues of the chest wall, then in the lymph nodes of the axilla or supraclavicular region on the affected side, and in the opposite breast, in this order of frequency. Nodules in the skin of the chest wall, in the parasternal region, are the most common type of skin recurrence following radical mastectomy. Other similar manifestations include recurrence in the scar, isolated nodules in the skin, multiple nodules of carcinoma *en cuirasse*, and the carcinomatous dermatitis referred to as inflammatory or erysipeloid cancer (figs. 1, 5, 6, 9).

The use of irradiation therapy to supplement surgical excision has prolonged the life of some patients with recurrent cancer of the breast or chest wall. Many, however, do not receive the benefit of irradiation when the disease has recurred, and only rarely is the surgeon willing to make a second attempt to eradicate the disease.

The criteria for inoperability should not influence the surgeon to exclude operation for palliative reasons, in cases in which irradiation is inadequate or contraindicated; nor should it be assumed that all of these patients are definitely incurable, as was the assumption in the cases here presented.

PRESENTATION OF CASES

Case 1. Successful graft to the pericardium. A 44 year old white woman was admitted to the Duke Hospital May 10, 1945. Ten years previously, a mass had developed in the left breast which was excised at another hospital. It promptly recurred and a radical mastectomy was performed by a second surgeon. During the ensuing year, she received

intermittent irradiation therapy, following which she remained asymptomatic for 5 years, when the lesion recurred in the chest wall. A biopsy was taken and histologic sections disclosed a "recurrent medullary carcinoma." The lesion was considered "inoperable" and palliative irradiation was instituted. The patient was given a total of 2100 roentgen units to the primary recurrence with the use of 200 kilovolts, 30 centimeters' distance, 0 2 tin filter. Three months later, this same area was given 2200 roentgen units with 200 kilovolts, 30 centimeters' distance, 0.5 copper filter, with the lesion well shielded. The patient returned 12 months later with numerous areas of recurrence in the skin of the chest wall each of which was treated separately by superficial x-ray therapy. She was also given 1200

FIG. 1. *Case 1.* A. A large recurrent carcinoma of the chest wall following radical mastectomy and irradiation therapy. The patient could not tolerate additional irradiation. Her condition was thought to be inoperable. The lesion was widely excised together with the underlying ribs and sternum. Split skin grafts were applied directly to the pericardium and chest wall. B. Position of graft covered pericardium in forced expiration C. Grafted pericardium is drawn inward at beginning of inspiration. Photographs B, C show pericardial graft about twenty months following operation.

roentgen units as a sterilization dose. The lesions subsided, but when they recurred 1 year later, she could not tolerate any additional irradiation, whereupon she was admitted to the hospital for operation There was a large recurrent carcinoma of the left chest wall, with ulceration and secondary infection (fig. 1A). An exposed rib could be seen at the base of the ulcer. The surrounding skin was thin and telangiectatic. Pain was constant and intractable

Operation. Excision of recurrent carcinoma of the chest wall; application of split thickness skin grafts to pericardium and chest wall. On May 12, 1945, with the patient anesthetized with sodium pentothal and nitrous oxide, a closed system being used, the entire chest, abdomen, and one thigh were prepared as a sterile field. The proposed area of excision was widely outlined by a toothpick moistened with 5 per cent alcoholic solution of brilliant green. The medial incision extended along the right lateral border of the sternum The superior limb followed the clavicle high into the axilla (fig. 2). The inferior incision began along the right costal margin and traversed the left costal margin. The lateral incision

followed the medial margin of the latissimus dorsi. The recurrent carcinoma and the soft tissues of the entire left chest wall were removed *en bloc* beginning at the periphery. The tumor had invaded the underlying ribs, and parts of the sternum together with the third, fourth, fifth, sixth, and seventh ribs were resected and the pericardium was exposed (fig. 2). There were no visible or palpable implants in the pericardium, mediastinum, or pleura.

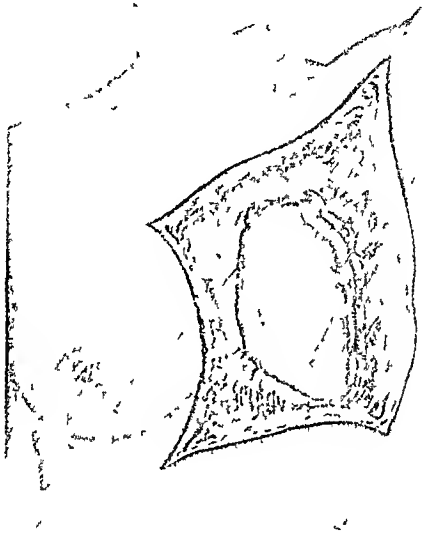


FIG. 2. *Case 1.* The recurrent carcinoma was widely excised. The tumor had invaded the underlying ribs, parts of the sternum together with the third, fourth, fifth, sixth, and seventh ribs were resected. The pericardium and left pleural cavity were exposed.

By approximating the four corners, this massive operative defect was reduced to one whose dimensions were 9 inches in length and 8 inches in width (fig. 4). It did not seem feasible to attempt to cover the defect with a direct transfer flap from the abdomen or back, nor to utilize the right breast, which was quite small. There was no alternative other than to tack the pericardium to the intercostal muscles and sternum (fig. 3), by interrupted sutures of white silk. Although the heart was seemingly lifted forward by this tacking procedure, there was no visible interference with its function. Two large heavy split thickness skin grafts cut from the thigh were sutured to cover the operative defect which measured 8 inches wide (17.6 cm.) and 9 inches long (19.8 cm.) (fig. 4). The suture ends were not cut so that they could be tied over a bolus of cotton waste to obtain pressure on the graft, directly over the pericardium. The operative area was dressed 10 days later at

FIG. 3. *Case 1.* The pericardium was tacked to the intercostal muscles and fascia covering the sternum, using interrupted sutures of white silk, so as to form a surface on which a graft could be placed. Although the heart was lifted forward by this tenting procedure, there was no visible interference with its function.

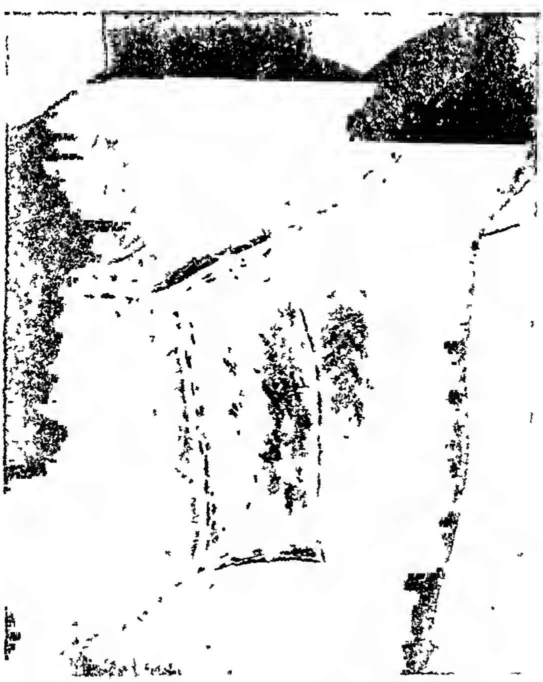
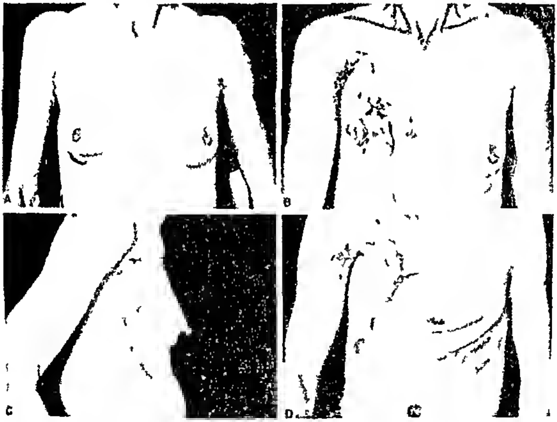


FIG. 4. *Case 1.* The large operative defect of the chest wall was somewhat reduced in size by approximating the corners. Two heavy split thickness skin grafts cut from the thigh were used to cover the defect which measured 8 inches in width and 9 inches in length.

from hospital



fect was closed and covered by transposing the left breast on a *superior pedicle* A split skin graft was used to resurface the area from which the breast flap was taken

which time there was an almost complete "take" of the graft, except for a 1 centimeter area over a protruding portion of a resected rib which did not completely heal for several weeks The patient was last seen approximately 20 months following the operation at which time the graft-covered pericardium appeared as shown in fig. 1A, B. She did not wear a protective support. The electrocardiogram was normal, and no murmurs were heard over the heart. There was no evidence of local recurrence or distant metastases

The graft has remained soft and semitransparent. Cardiac contractions and pulsations are clearly visible. Forced expiration with increased intrapulmonary pressure causes the graft-covered pericardium to bulge beyond the surrounding chest wall (fig. 1B, 4). When

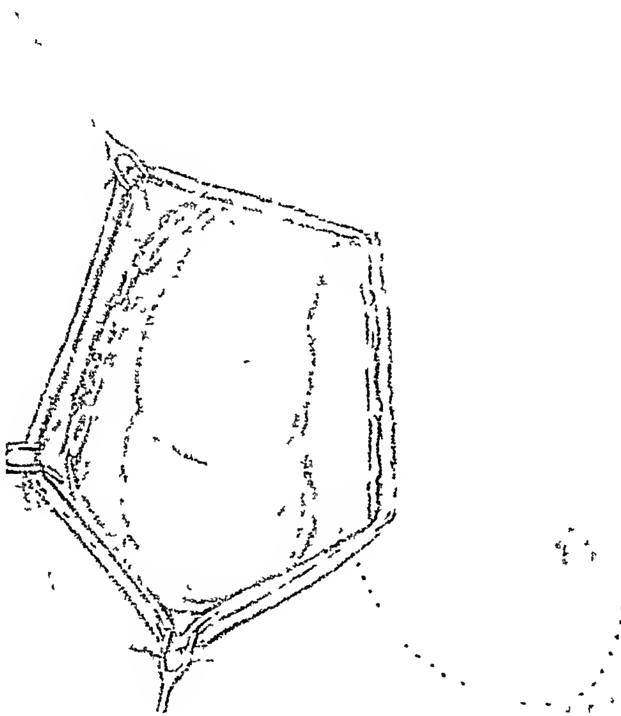


FIG. 7. *Case 3.* In an attempt to eradicate completely the tumor, the right lateral half of the sternum, the third, fourth, fifth, sixth, and seventh ribs were resected. To mobilize the breast, a sweeping incision was made from the xiphoid to the axilla Care was exercised to avoid injury to the blood supply of the breast.

the patient decreases her intrapulmonary pressure, the graft-covered pericardium is drawn inward below the level of the chest wall (fig. 1C). Violent waves are seen when the patient coughs.

So far as we are aware, this is the first time that a skin graft has been applied directly to the pericardium.

Case 2. A 26 year old married colored woman was admitted to the General Surgical Service of the hospital November 19, 1946. About two and one-half months previously she first noted that the right breast was larger and firmer than the left. The increase in size progressed rapidly and occasioned some discomfort because of the added weight This was

relieved partially with a home-made support. She sought the advice of her local doctor who told her that she had a breast abscess and that immediate incision was necessary. This was performed without anesthesia two weeks prior to admission. No fluid was obtained immediately, although a thin discharge persisted for about one week. Subjective chilly sensations hastened her admission.

Physical examination disclosed a healthy-appearing young colored woman whose right breast was more than twice the size of the left (fig. 5A). Induration was extreme and diffuse; no individual masses could be felt. The skin covering was taut and shiny; the

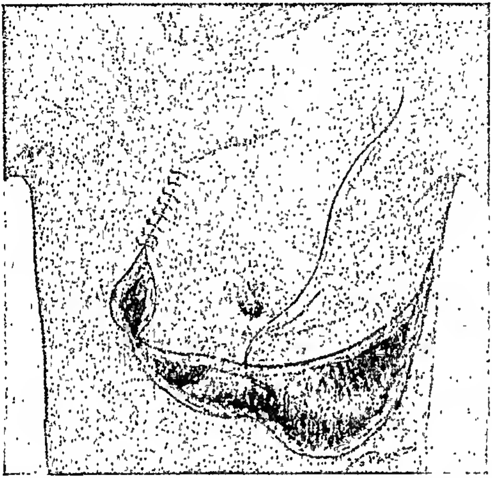


FIG. 8. *Case 8.* To decrease the size of the operative defect the ribs were resected to the midaxillary line. This allowed the right lateral skin margin to approximate that of the transposed breast. After several sutures of braided silk were inserted at cardinal points, the subcutaneous tissues and skin were closed with interrupted sutures of silk. The chest was not drained. A split thickness skin graft, cut from the thigh, was used to resurface the denuded area of the left lower chest wall.

nipple was inverted. The breast was not tender. Several enlarged nodes were present in the right axilla. Roentgenograms of the chest disclosed no abnormalities.

A preoperative diagnosis of sarcoma of the breast was made by Dr. William Hollister, who performed a radical mastectomy on November 22, 1946. Pathologic studies disclosed the tumor to be a "sarcoma of the breast with invasion of the axillary lymph nodes." During her convalescence, she was given 2000 roentgen units over the anterior axillary and supraclavicular regions, and this same dosage was administered posteriorly using 200 kilovolts, 50 centimeters' distance, and a 1 mm. copper filter, as a palliative measure. All operative incisions healed per primam and she was discharged December 7, 1946.

Six weeks later the patient returned complaining of pain in the sternum, where a recurrent mass was located (fig. 5B). It was stony hard and fixed to the sternum and adjacent ribs. Roentgenograms of the chest, skull, vertabrae and pelvis disclosed no significant

abnormalities. Since sarcomas of the breast are radio-resistant (6), operation was decided upon.

Operation. Excision recurrent sarcoma of chest wall; resection of sternum, second, third, fourth and fifth ribs. Transplantation of left breast to operative defect of right chest wall using inferior pedicle. Application split skin graft, thigh to left upper chest wall. With the patient anesthetized with sodium pentothal and supplemented with nitrous oxide and oxygen through a closed system, we circumscribed widely the recurrent sarcoma of the chest wall, and resected the sternum, second, third, fourth and fifth ribs. The entire mass was removed *en bloc*. There was, however, an extension of the tumor into the right upper lobe of the lung, and to remove it a small segment of this lobe was resected. To cover primarily this large operative defect, a crescent-shaped incision was made over the axillary extension of the left breast, and having elevated the organ with meticulous care to preserve its blood supply, it was transposed to the center and right side of the chest. Interrupted sutures of 0000 silk were inserted into the subcutaneous tissues and skin. The chest was not drained. A split thickness skin graft cut from the thigh was used to cover the defect in the left upper chest wall. The breast-flap-graft and the free graft healed primarily and the patient was discharged on the thirteenth postoperative day, February 5, 1947 (fig. 5C, D)

Pathologic studies disclosed the tumor to be the same fibrospindle-cell sarcoma which previously had completely invaded the breast, and now had recurred in the sternum, ribs and lung.

SARCOMA OF THE BREAST

The total number of reported cases of sarcoma of the breast is small. It has been estimated (6) that carcinoma is several hundred times as frequent as sarcoma. If the epithelial and mesenchymal elements of the breast were equally susceptible to malignancy, sarcoma rather than carcinoma would be the most common malignant condition, particularly in women who have borne few or no children. This discrepancy suggests that the degree of specialization in the affected tissue rather than its amount is a determining factor in its susceptibility to malignancy.

Clinical Features. The distinguishing clinical features of mammary fibrospindle-cell sarcomas are the rapid growth, large size and firm consistency of the tumor (fig. 5A). While "involvement of the axillary nodes is usually absent," (6) in the present case the axillary nodes were invaded.

Pathology. Histologic sections reveal interlacing bands and whorls of fibrospindle-cells. In other fields myxomatous degeneration is present, and pleomorphic cells with bizarre nuclei are embedded in a loose, pale matrix.

Treatment. The treatment is primarily surgical for these tumors are radioresistant and irradiation, except in palliative form, is not recommended (6).

Case 3. A 50 year old white woman was admitted to the General Surgical Service January 13, 1947 stating that following an accidental blow five months previously she had developed a mass in the right breast (fig. 6A). This began as a small non-tender mass, but as it increased in size it was associated with burning pain. Several days prior to admission, ulceration of the skin developed which was accompanied by a serosanguinous discharge. Physical examination revealed an ulcerated, discharging five centimeter mass located in the lower central quadrant of the right breast. It was freely movable over the chest wall. Several enlarged nodes were present in the right axilla. Dr. Paul Schanher performed a radical mastectomy on January 20, 1947. A wide *en bloc* excision was performed and the resulting defect was covered with a split skin graft. Histologic studies showed a "medullary car-

cinoma of the breast with axillary metastases." The patient was given 2000 roentgen units to the right upper anterior and posterior chest respectively during her convalescence. The incisions and graft healed primarily and she was discharged February 6, 1947 on her eighteenth postoperative day.

In less than six months, the patient returned with an extensive recurrence in the sternum, ribs and graft site (fig. 6B), which was demonstrated on roentgenograms. Since the patient could not tolerate any additional irradiation, operation was decided upon.

Operation. Excision recurrent carcinoma of chest wall; resection of sternum, third, fourth, fifth, sixth, seventh ribs. Transposition of left breast to right chest wall defect. Application of split graft to left lower chest wall. With the patient anesthetized with sodium pentothal and supplemented with nitrous oxide and oxygen through a closed system, an *en masse* resection was performed in which the right lateral half of the sternum and the third to seventh ribs were removed (fig. 7). There were no implants in the axilla, pleura, mediastinum or lung. To cover this large chest wall defect, a sweeping incision was made below the mammary fold (fig. 7) and the entire breast was mobilized being careful to avoid injury to the lateral thoracic artery, which as Maliniac (11) has shown carries about half of the blood sup-

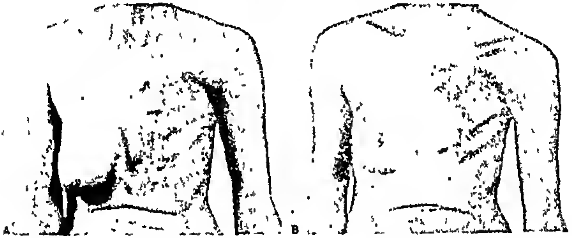


FIG. 9. *Case 4.* A. Recurrent carcinoma of the skin, sternum, manubrium, and ribs fol-

ply to the breast. The left breast was then transposed on its *superior pedicle* to cover completely the right chest wall defect (figs. 6C, D, 8). So that closure could be effected without tension, it was necessary to resect the ribs to the mid-axillary line (fig. 6C). The lung was inflated and after anchoring the flap at key points with sutures of braided silk, the chest was closed without drainage using interrupted sutures of 0000 silk. A split graft, cut from the thigh, was then used to resurface the donor defect of the left lower chest. The silk suture ends were left long to tie over a bolus of machinist's waste in order to immobilize the area and to exert constant pressure on the graft.

The patient's postoperative course was an uneventful one. The original dressing was removed in one week. The transposed breast flap and the free graft had "taken" completely. 250 cubic centimeters of bloody fluid was aspirated from the right side of the chest at this time, and this was repeated every other day for one week, at which time no fluid could be obtained. The patient walked at the end of two weeks and was ready for discharge in three weeks (fig. 6C, D).

Although one cannot give any assurance that the carcinoma has been completely removed, nevertheless, the condition was not an inoperable one, and the operation must be considered of value if life has been prolonged and if she has been spared the pain and misery to which she was certainly predestined.

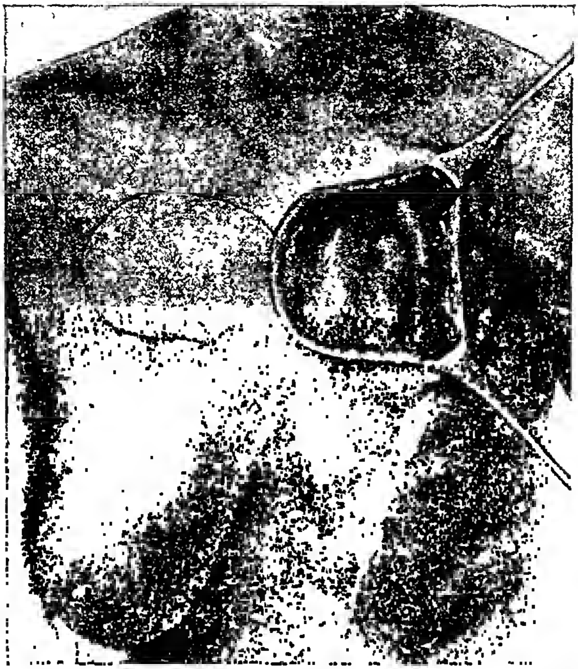


FIG. 10. *Case 4.* The recurrent carcinoma was removed by resecting parts of the manubrium, sternum, second and third ribs. The great vessels at the base of the heart were exposed. A flap from the right chest wall was outlined with brilliant green.

FIG. 11. *Case 4.* A direct transfer single pedicle flap from the right upper chest wall was transposed and sutured in position to cover the operative defect, two rows of interrupted silk sutures being used. By drawing the right breast upward, the donor area could be closed.

Case 4 ♀ A 45 year old colored woman was first admitted to the Duke Hospital January 9, 1945 Five months previously, she noted a mass in the left breast which continued to increase progressively in size She had lost about 20 pounds in weight. Only 2 scanty menstrual periods followed the birth of her last child 2 years previously.

FIG 12. *Case 5.* A [illegible]

[illegible] years, her history of previous opera- [illegible]

Physical examination showed a hard, slightly tender, freely movable mass measuring 3 by 5 centimeters located in the upper inner quadrant of the left breast Although several axillary lymph nodes were palpable, they were not interpreted as metastases She had hypertensive cardiovascular disease. The blood pressure was 290 systolic and 140 diastolic. A roentgenogram showed the heart to be moderately enlarged The aorta was tortuous.

There was a harsh blowing systolic murmur heard over the entire precordium. Serologic tests for syphilis were strongly positive.

The general surgeons performed a radical mastectomy using a "wide *en bloc* excision." Since the skin flaps could be approximated, a skin graft was not used. Pathologic sections disclosed an "adenocarcinoma of the breast without axillary metastases." During the convalescence, she received 2000 roentgen units of irradiation through two ports.

She remained well for almost 1 year. Upon returning for a checkup examination on January 4, 1946, she was found to have a hard, fixed recurrent neoplastic mass in the skin

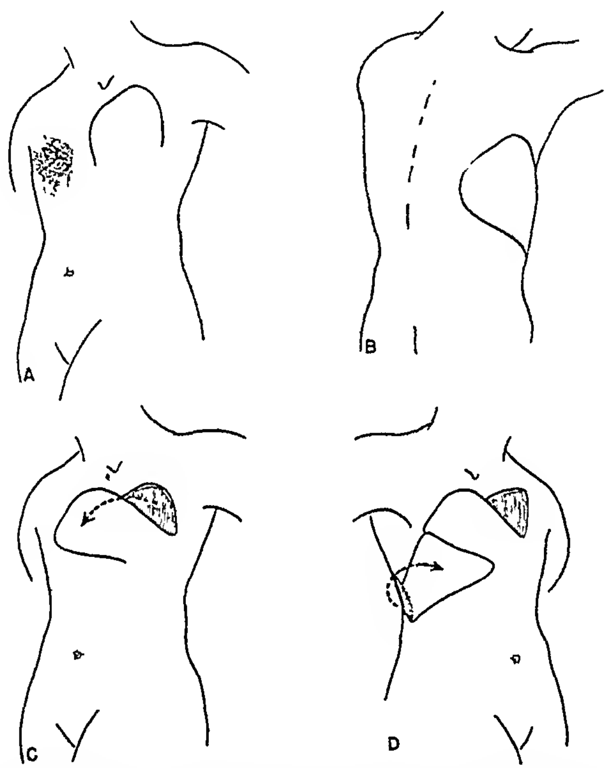


FIG 13. Sketch to illustrate resurfacing of chest wall using two flaps, *Case 5*. A. Delayed transfer single pedicle flap, left anterior chest wall. B. Delayed single pedicle flap from right postero-lateral chest wall. C. Posterior flap transposed anteriorly to resurface right lower chest wall. D. Anterior flap transposed to resurface upper chest wall, following excision of basal cell carcinoma.

and sternum overlying the junctions of the second and third ribs on the left side (fig. 9A). A roentgenogram of the chest showed the "heart to be tremendously enlarged in its transverse diameter." No destruction of the sternum or ribs was discernible.

Operation. Excision recurrent carcinoma of sternum and ribs; application direct transfer flap from upper chest wall. On January 6, 1946, with the patient anesthetized with ether, a closed system being used, an incision was made to encircle widely the recurrent carcinoma. The medial parts of the second and third ribs, together with the left lateral margin of the sternum and manubrium were resected. The pleura was opened. The great vessels at the base of the heart appeared normal. No pleural implants could be felt.

The remaining breast was thin and pendulous (fig. 9A) and could be readily mobilized

upward A direct transfer single pedicle flap was measured and outlined with brilliant green (fig 10) It was then incised, transposed and sutured to cover the operative defect two rows of interrupted sutures of silk being used The area from which the flap was taken was closed in a similar manner by drawing the breast upward (fig 11) Pathologic sections disclosed a recurrent adenocarcinoma of the sternum and ribs All incisions healed *per primam* and the patient was discharged on the tenth postoperative day (fig 9B)

LOCAL SPREAD OF MAMMARY CANCER

While a great deal has been written concerning regional and distant metastases from carcinoma of the breast, relatively little attention has been given to the factors which govern local invasion and recurrence of the growth And yet the control of the original or the recurrent lesion may thwart the development of regional extension or distant metastases Regardless of the type of mammary cancer, it first shows disruption of the basement membrane of the epithelial structures involved (6) The cancer cells thus gain access to the neighboring lymphatic and tissue spaces and extend into the surrounding stroma Since the organ affected contributes new blood vessels and a growth of connective tissue to the cancer, the malignant tumor may surround itself with a new and more extensive vascular bed or enclose itself in a dense wall of fibrous tissue When an extensive vascularity is provoked by this new cancerous growth, additional opportunities for its spread are provided Hence, it invades the surrounding mammary tissue by 1) dissolving through existing connective tissue membranes, 2) extending along pre-existing lymphatics and tissue spaces, and 3) by penetrating newly formed vascular spaces which appear in response to their growth

The extent to which the cancer is dispersed in the breast is influenced by the age of the patient and the physiologic state of the gland The amount of proliferating material from which the cancer arises is greater and the degree of vascularity in the surrounding tissue more marked in young individuals and during pregnancy and lactation This may account for the more rapid spread of the disease in these patients (fig 5A) Conversely, the occlusion of vessels and tissue spaces which is found in the involuted breast of elderly patients may account for the better prognosis of cancer in these individuals The rate, extent and manner in which the cancer is dispersed in the breast determines in a large measure the probability of local recurrence, regional spread, and distant metastases Hence, these are most important factors in treatment and ultimate prognosis

Local Extension and Regional Invasion The overlying skin and underlying fascia as well as the regional lymph nodes are commonly involved in mammary cancer Handley (14) stressed the importance of the lymphatics as a pathway of invasion to the surrounding structures He demonstrated the frequency with which, by their process of repeated multiplication, cancer cells extended in a line along the lymphatics of the fascial planes Interruptions in this gradual spread or permeation were attributed to secondary fibrosis of the lymphatics following their permeation by cancer cells Handley, however, minimized the importance of direct invasion and also the importance of emboli of tumor cells which gained access to the blood or lymphatics Nevertheless, the extension of

cancer does occur by all three methods: direct invasion, by lymphatic permeation, and by transportation of cancer emboli (15).

The Skin. The skin may be affected by mammary cancer in several ways. The attachment of Cooper's ligaments, which pass from the mammary stroma to the skin, may be invaded so that shortening and pull on the overlying skin occur—*dimpling.* The expansion of the tumor may cause pressure changes in the skin, which becomes thin, shiny (fig. 5A), discolored, or ulcerated (fig. 12A). Invasion of the lymphatic plexus, which forms a network in the subcutaneous tissue, may cause blockage of one or more radicles producing edema and the characteristic *orange peel appearancc.* When this is widespread, the skin has the erysipeloid appearance seen in inflammatory cancer, or, the nests of cells causing the blockage may grow until one or more nodules are formed as seen in carcinoma *en cuirasse,* where the entire chest may be studded with such masses. The removal of a maximum amount of skin in a circular area overlying the tumor, using the center of the tumor as the center for the circular skin incision, is one of the cardinal principles of Halsted's radical mastectomy, and demonstrates the importance he attached to the dangers of skin involvement.

The Lymphatics. Handley *(14)* found that mammary cancer in most instances travels along the lymphatic vessels of the muscular aponeuroses extending over the pectoralis fascia, rather than invading the muscle fibers. The lymphatics of the breast have their origin about the ducts and acini, collecting upward toward the nipple to form the subareolar plexus, or toward the periphery to form the deep fascial plexus which extend to the axilla. From the axillary nodes the lymphatics follow the course of the axillary vein beneath the clavicle, some passing by way of the supraclavicular nodes and others directly to the thoracic duct, and then into the superior vena cava. The relatively early extension of cancer cells along these pathways to the regional lymph nodes is the basis for their removal by a careful axillary dissection. If these malignant cells gain entrance to the thoracic duct or vena cava, *distant metastasis* will occupy the lungs and pleura, liver, bones, and the brain, in this order of frequency, and may involve any of the internal viscera. Distant metastasis usually occurs after invasion of the regional lymph nodes, but may occur without it.

DISCUSSION

It is generally agreed that radical mastectomy affords about 65 per cent of 5 year survivals, when the cancer is confined to the breast, but there are only about 20 per cent of such survivals when the disease has spread to the regional lymph nodes (6). Of all the operable cases who have had a radical mastectomy, about one third will return at some future time with a recurrent lesion (8), and this, whether or not they have received irradiation. In spite of this, few operations have been designed for the eradication of neoplastic processes recurring after removal of tumors of thc breast and chest wall either by surgery or by irradiation. The use of irradiation therapy to supplement surgical excision has prolonged the life of some patients with recurrent cancer of the breast, but many do not receive the benefit of irradiation when the disease has recurred, and only rarely is the

surgeon willing to make a second attempt to eradicate the disease. The statements (6) that "recurrent or metastatic deposits of mammary cancer which make their appearance following radical mastectomy are manifestations of an incurable disease" and that "the disease cannot be eradicated in this stage by any of the therapeutic measures available at present" are, fortunately, no longer true. Any operation which improves the effectiveness of surgery or irradiation or which prolongs life must be considered of value (10).

The criteria for inoperability should not influence the surgeon to exclude operation for palliative reasons, in cases in which irradiation is inadequate or contraindicated; nor should it be assumed that all of these patients are inoperable or incurable, as was the assumption with the patients which have been presented. On the other hand, however, extirpation of primary or recurrent tumors should never be undertaken lightly, for one may have to remove a large portion of the chest wall (17–20). Watson and James (17) have advocated the use of fascia lata grafts to support the skin closure and to prevent pulmonary herniation following resections of the chest wall. This additional support may be a valuable adjunct to the reconstructive and thoracic surgeon.

Maier (21) has demonstrated beautifully the efficacy of using the opposite breast as a direct transfer flap to reconstruct post-irradiation defects of the thoracic wall.

Maliniac (11–13) has repeatedly stressed that one of the chief potential dangers in reconstructive surgery of the breast and chest wall is interference with the blood supply. Successful plastic surgical reconstruction demands the formation of vascular flaps and pedicles, and unless these are preserved, necrosis occurs and disaster will follow. Maliniac has found that the blood supply of the breast is provided by three main sources: the internal mammary, the lateral thoracic, and the intercostals.

There are some conditions of the breast and chest wall which may not respond well to ordinary procedures, but which can be greatly benefited by the application of the more specialized techniques developed in reconstructive surgery. Some of these have been presented.

CONCLUSIONS

Few operations have been described for the extirpation of recurrent neoplastic lesions of the chest wall, even though approximately one patient out of every three upon whom a radical mastectomy has been performed will return with a local recurrence.

Operative procedures have been designed and described for the extirpation of recurrent neoplastic lesions of the chest wall following radical mastectomy. These operations are also applicable to primary tumors. Direct transfer flap procedures utilizing superior, inferior, medial and lateral pedicles have been demonstrated. One case is presented in which a double flap was used.

A free skin graft was used successfully to cover the pericardium following resection of the chest wall.

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CONSTRUCTION OF SKIN-TUBE ESOPHAGUS, FOLLOWING SURGICAL TREATMENT OF TRACHEOESOPHAGEAL FISTULA

ROBERT H. IVY, M.D., HERBERT R. HAWTHORNE, M.D.
AND JOSEPH A. RITTER, M.D.

Various procedures have been proposed for reconstruction of the esophagus following resection for stricture due to caustic burns, malignant disease, or congenital anomalies. Where the gap is sufficiently small, direct anastomosis of the free ends may be possible. In other cases, an epithelium lined tube of transplanted tissue must be used to restore the continuity. This has been accomplished intrathoracically by carrying a segment of jejunum or a tubed portion of the stomach up to meet the upper stump of the esophagus. Extrathoracic methods comprise the formation of an epithelium-lined tube beneath the skin of the anterior chest wall, connected above with the opening in the neck of the upper stump of the esophagus and with the gastrostomy below.

In 1917 Esser (2) made an anterior thoracic esophagus by tunnelling beneath the skin of the chest and inserting a large rubber tube covered with Thiersch skin grafts. The rubber tube was withdrawn after several days, leaving the grafts to line the tunnel. The ends of this epithelial lined tube were later connected with the esophageal opening above and the stomach below. This method does not seem to have met with much favor, probably because of fear of later constriction.

We refer here to some of the more recent methods that have been proposed. In 1942, Davis and Stafford (1) reported a case of stenosis of the esophagus following lye burns. After the preliminary operations of gastrostomy and formation of a fistula of the upper stump of the esophagus in the neck, the extrathoracic esophagus was constructed by formation of a tube lined with inverted skin extending from the upper fistula down toward the gastrostomy opening, a tubed pedicle flap from the side of the body being used for covering. The lower end of this skin lined tube was later joined to the stomach by a segment of jejunum.

Longmire and Ravitch (5) employed for the lining of the tube a loop of jejunum ultimately completely isolated from its mesenteric blood supply. In several stages with successive severance of the vessels supplying it, the segment of jejunum was implanted in the skin tube, so that it finally was completely cut off from its original blood supply. The jejunum-lined skin tube was then transferred to the anterior chest to serve as a channel between the upper part of the esophagus and the stomach. One of the advantages claimed for jejunum as a lining for the tube is that peristalsis is present, thus aiding swallowing. Another is the alleged difficulty of getting skin to heal with gastric mucosa.

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Presented before the Philadelphia Academy of Surgery, January 5, 1948.

Stevenson (6) reports reconstruction of the esophagus with a skin-lined tube in two cases following resection for carcinoma. According to Stevenson's technic the lining is made by inverting the skin of the chest wall between the upper and lower fistulae and closing the raw area thus produced by undercutting the edges and drawing them together. This method is time-saving, obviating the various stages of tube pedicle formation, and was successful in the cases reported, yet in other cases it might be difficult to effect a closure of the skin gap in this way without causing undue pressure on the skin-lined tube beneath. Stevenson had no difficulty in obtaining union between the lower end of the skin tube and the gastric mucosa.

Ladd (3) reports an extensive experience of 34 cases with esophageal atresia and tracheoesophageal fistula, with 11 still living after various operations. In two of these, direct anastomosis was possible. In two, the anterior thoracic esophagus was completed, in a third it was in process of construction. The remaining six were all doing well and awaiting construction of an anterior thoracic esophagus.

In a more recent paper, published in January, 1947, Ladd and Swenson (4) discuss the subject further. They recommend attempted direct anastomosis if the gap is not more than 2 cm. In the last 14 cases operated on for closure of the fistula there has been only one death. Five cases of construction of an anterior thoracic esophagus have been completed and 11 others are waiting for the procedure. The authors apparently prefer to use a loop of jejunum to connect the skin tube with the stomach.

Attention is also called to a recent article by Hanrahan (7), in which he reports the use of a skin flap for both lining and covering of an esophageal tube to connect upper and lower fistulae 8 cm apart.

In the case about to be reported, the technic described by Ladd was followed as closely as possible.

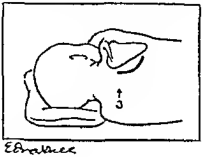
G. K., a male infant was admitted to Graduate Hospital, Philadelphia, January 28, 1946, four days after birth. The delivery had been normal, full term, and birth weight was 7 lbs. 9 oz. The baby seemed to have a great deal of mucus in the throat the first day after birth, and was unable to take nourishment. The second day, each time he was put to the breast he vomited. The third day the vomiting continued and seemed projectile in character. The temperature was around 100°F.

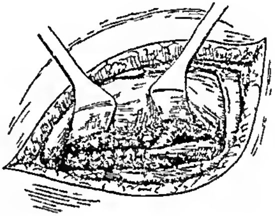
On admission to Graduate Hospital, the vomiting continued and 70 cc. of normal saline was given by clysis. The baby then weighed 5 lbs., was greatly dehydrated, very restless and held himself rigid. Physical examination of the head, fontanelles, ears, pharynx and heart showed nothing abnormal. A few coarse rales were heard in the lungs. No peristaltic waves were evident in the abdomen. The main feature on examination was the extreme dehydration.

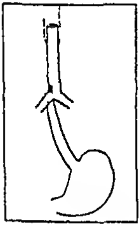
In 24 hours the baby received 450 cc. of fluid, intravenously and by clysis, glucose in normal saline and plasma. Bronchoscopic aspiration brought out a moderate amount of material from the trachea and esophagus.

X-ray examination at this time showed heart and mediastinum deflected to the right, with associated opacity in the right lower lung field, indicative of an atelectasis with emphysema of the left lung. The picture was also suggestive of an esophageal stenosis with a racheoesophageal fistula.

Jan 30, '46 Operation by Dr Hawthorne, six days after birth Posterior approach to ight side of chest by resection of portions of 3rd, 4th and 5th ribs An esophageal pouch as found, ending at level of T 4 A fistula between distal esophagus and right main ronchus was ligated With ligation of a branch of the azygos vein ready access to this area as obtained (fig 1) The gap in the esophagus was too great for direct anastomosis The perative procedure was well tolerated, 80 cc of blood and 60 cc 5% glucose in water being dministered during the course of the operation







s and the reflected

Feb 1, '46 The child now had a good color and dehydration was largely overcome by daily multiple clyses and intravenous plasma, saline and blood

Feb 2, '46 Gastrostomy by Dr Hawthorne The gastric wall was tented around a large mushroom catheter so that the wall could be attached to the skin (fig 2)

Feb 4, '46 Skimmed milk feeding started through the gastrostomy tube With the institution of gastrostomy feedings there was a very early and rapid improvement and as the frequent aspirations of the pharynx were adequate and the lungs continued to clear it appeared advisable to wait a few days for the exteriorization of the proximal blind pouch of the esophagus

Feb 8 '46 six days after the gastrostomy the superior mediastinum was entered through an incision along the lower anterior border of the left sternomastoid muscle The blind end of the esophagus was freed with finger dissection and brought out on the chest wall through a tunnel under the skin It was not opened for two days in order to allow a proper sealing of the mediastinal structures (fig 2)

Following this operation, general improvement in the child's condition continued until on June 11, four months later, he weighed 16 lbs 2 oz , and was considered sufficiently robust

for construction of the new esophagus to be started (fig. 3). There was a free flow of saliva from the esophageal fistula in the neck, and he was induced to take considerable quantities of water by mouth to keep up activity of the muscles of deglutition.

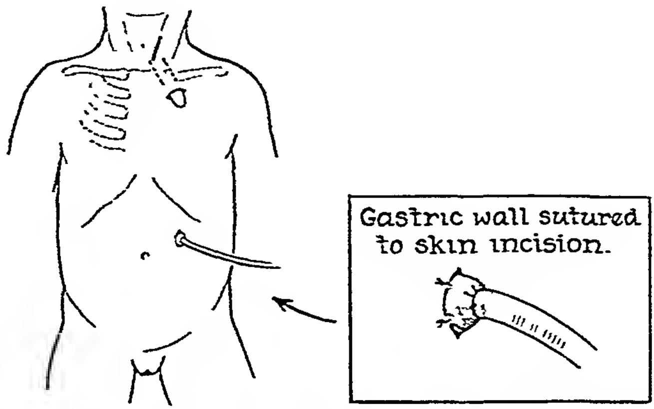


FIG. 2. GASTROSTOMY—SECOND STAGE PROCEDURE. EXTERIORIZATION OF UPPER END OF ESOPHAGUS—THIRD STAGE PROCEDURE

FIG. 3. SHOWING ESOPHAGEAL FISTULA IN NECK AND GASTROSTOMY BELOW

June 14, 1946, at 4½ months of age, the first of a series of operations was done by Dr. Ivy in construction of a skin-lined tube to connect the esophageal fistula in the neck with the gastrostomy opening. The various stages are shown as depicted in the diagrams.

Fig. 4 shows operation done on June 14, 1946. Preparation of long tubed flap along right side of body, to be used as covering of skinlined tube, to be made later down front of chest.

Figs. 5 and 6 illustrate operation done Sept. 20, '46. Lower end of tube pedicle from side of body sutured just above fistula in neck in form of a hood.

FIG. 4. CONSTRUCTION OF SKIN-TUBE ESOPHAGUS, STEP 1. A THORACO-ABDOMINAL TUBE IS MADE ON THE RIGHT SIDE OF THE BODY

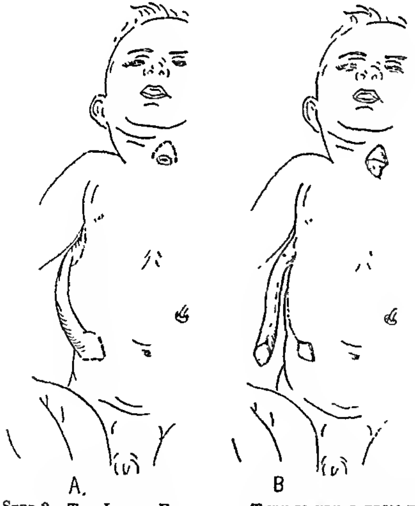


FIG. 5. STEP 2. THE LOWER END OF THE TUBE IS FREED FROM THE CHEST WALL. A TRIANGULAR FLAP IS TURNED DOWN FROM THE AREA RIGHT ABOVE THE ESOPHAGOSTOMY OPENING

Figs. 7, 8 and 9: Operation October 25, '46. Formation of lining tube by turning skin over after making vertical parallel incisions down front of chest about two-thirds of the distance to the gastrostomy opening. The resulting raw surface was then covered by opening out the tubed pedicle from the side of the body. This resulted in the formation of a

FIG. 6. Step 2, continued. A—The lower end of the tube is sutured to the triangular flap. B—The suturing is made in such a manner that the esophagostomy opening is left untouched.

skin-lined tube from the opening in the neck with its lower end about two-thirds the required distance to the gastrostomy opening.

Dec. 27, '46, a similar tube pedicle was made low down on the left side, to be used to cover the continuation of the skin lining for the remainder of the tube (fig. 10A).

Fig. 10B shows attachment of end of covering flap around gastrostomy opening in same manner that end of flap from right side was attached around esophageal opening above. This operation was done March 14, '47.

On May 2, '47, the construction of the lower part of the esophageal tube to the gastros-

Fig 7. Step 3 The upper end of the tube is detached from the chest wall Two parallel incisions are made on the anterior chest wall, vertically downward toward the gastrostomy opening

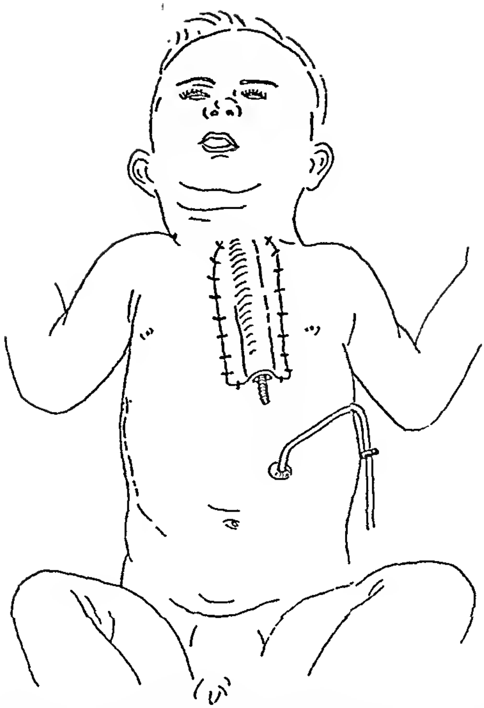
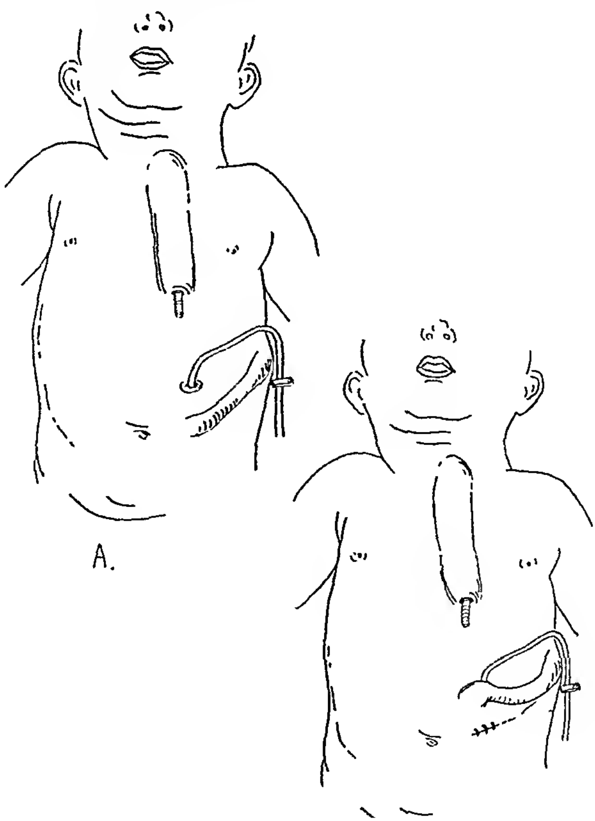


FIG. 9. Step 3, continued. The thoraco-abdominal flap which has previously been opened, is sutured over the raw surface of the inner tube.



tomy opening was completed The lining was made by turning over a flap of skin from each side in the same manner as illustrated for making lining of upper part of esophageal tube Fig 11 illustrates completed esophageal tube and closure of gastrostomy opening

Following the anastomosis of the lower end of the skin tube with the gastrostomy opening, feeding by mouth was begun the next day While some of the ingested fluid passed into the stomach, part of it was retained in the skin tube and vomited This indicated an obstruction at the point of anastomosis To supplement feeding at this time on May 14 1947, Dr Hawthorne performed a jejunostomy

May 20, '47, X ray studies showed a constriction at the point where the skin tube joined the stomach Feeding by mouth and by jejunostomy tube was then continued until July

Fig 11 Step 6 The lower half of the prethoracic esophagus is constructed in the same way as in Step 3

11, 1947, when Dr Ivy reopened the skin flap to expose the narrow anastomosis of the skin tube with the stomach The opening in the gastric mucosa was enlarged and sutured to the end of the skin tube in such a manner as to maintain the enlarged lumen right into the stomach The covering flap was sutured back in place Following this, a small external leakage persisted for a time, but finally closed and food from the mouth entered the stomach without difficulty

Sept 2, '47, X ray examination showed the following The stoma between the prethoracic esophagus and stomach seems to be of adequate caliber The prethoracic esophagus itself is normal in configuration and there is no evidence at present of any foreign body Barium flowed from the esophagus into the stomach readily in all positions except the right lateral recumbent position where there is moderate regurgitation from the stomach back into the esophagus The stomach fills normally and is normal in shape Peristalsis is not observed on repeated examination However, the emptying time of the stomach is not abnormal

There is no evidence of gastric retention. Duodenum negative. The three or four inches of proximal jejunum lying between the duodenum and the tip of the jejunostomy tube are sufficiently demonstrated to show that there is no obstruction or other abnormality.

FIG. 12. PATIENT AFTER COMPLETION OF SKIN-LINED ESOPHAGUS

FIG. 13. SHOWING PATIENT BEING FED ENTIRELY BY MOUTH

At this time, there were recurrent episodes of apparently burning pain in the skin tube with regurgitation and vomiting of previously ingested food. On Sept. 11, '47, a binder was placed over the lower end of the thoracic tube after each feeding. No more regurgitation and vomiting were noted after this pressure was applied.

On October 2, 1947, it was considered safe to remove the jejunostomy tube the jejunostomy closed spontaneously in about a week, and feeding entirely by mouth has proceeded since (fig 12) Weight at this time was between 24 and 25 lbs The child was taking practically a normal diet for one of his age (fig 13) He was discharged from the hospital November 3, 1947

The following is a summary of the dietary used throughout

Feb 3, '46 Formula via stomach tube	
Skimmed milk	8 oz
Water	8 oz
Dextri Maltose	1½ tablespoons
Feb 4, '46 Formula 12 times 2 oz	
Skimmed milk	12 oz
Water	12 oz
Dextri Maltose	4 tablespoons
Casec	2 tablespoons
Ascorbic acid	100 milligrams
Oleopercomorpheum	20 drops
Feb 12, '46 Formula 12 times 2 oz	
Skimmed milk	14 oz
Water	10 oz
Casec	4 tablespoons
Dextri Maltose	4 tablespoons
Ascorbic acid	100 milligrams
Oleopercomorpheum	20 drops
Lactic acid	15 drops
Feb 17 '46 Formula 8 times 3 oz	
whole milk	18 oz
Water	6 oz
Dextri Maltose	4 tablespoons
Multibeta	15 drops
Ascorbic acid	100 milligrams
Oleopercomorpheum	20 drops

Mar 4, '47 Formula changed to evaporated milk
12 noon p Broth thickened with vegetable puree
3 P M Cereal gruel 5 oz , thickened with ground meat or liver
May 7, '47 Fluids by mouth
May 8, '47 Protolysate and skimmed milk, instead of evaporated milk
September 3, '47 Cereal, Junket, banana, puddings, Jello, formula—all by mouth

CONCLUSION

Many difficulties were encountered in this case, demanding closest attention and cooperation of pediatricians, nurses and surgeons Care of the skin to minimize excoriation at the gastrostomy opening, regulation of the diet, prevention of anemia, combating respiratory infections, and other factors all contributed to the so-far successful result The ultimate outcome is of course unpredictable and can only be determined by close follow up and future studies

COMMENT BY DR RITTER

Various types of esophageal atresia and fistula result from incomplete separation of the early laryngo tracheal groove from the ventral surface of the esophagus Approximately 75 per cent of the reported cases are of the type in which

the upper esophageal segment ends in a blind pouch and the lower segment communicates with the trachea or one of the primary bronchi.

Esophageal atresia with or without tracheoesophageal fistula is not infrequently encountered in the newborn infant. It is a serious congenital anomaly and if left untreated is incompatible with life. Death may occasionally ensue from associated anomalies, but most often is due to starvation and complications arising from aspiration of overflow from the upper segement or regurgitation of gastric juices into the tracheobronchial tree from the lower segment. The hopelessness attending esophageal atresia prior to 1939 has been replaced by reports of many therapeutic surgical successes. Earlier diagnosis, new surgical technics and improved surgical judgment in selection of cases and type of operation employed will continue to decrease the 60 to 80% mortality rate.

Early diagnosis can be made with comparative ease if the condition is kept in mind. Any newborn infant exhibiting excess saliva or mucus at birth should be suspected. This is especially true if episodes of regurgitation, possibly cough and cyanosis, occur before any feedings have been given to the infant. Affected infants are intolerant to even very small feedings which are promptly regurgitated, sometimes accompanied by cough and cyanosis. Abdominal distention is frequently seen because in most cases the lower segment communicates with the trachea or a bronchus. Due to aspiration pulmonary signs are usually present. The diagnosis can be readily verified by passing a small rubber catheter, under fluoroscopic guidance, into the esophagus to the level of the obstruction. Aeroesophagraphy or the installation of a few cubic centimeters of lipiodol are useful diagnostic aids. Barium should not be used as a contrast medium because aspiration may lead to severe pulmonary inflammation.

Preoperative treatment may include postural drainage, continuous suction and bronchoscopic aspiration. Fluid and electrolyte balance should be maintained. Blood and plasma may be administered if necessary before, during and after operation. The use of antibiotics will depend upon pulmonary complications, condition at operation and postoperative complications.

From a pediatrician's viewpoint, the operation of choice, when possible, is primary anastomosis. The multiple-stage operation with or without a jejunal segment or a free jejunal transplant is a formidable amount of surgery and has psychological implications for the patient. The multiple-stage operations require extensive hospitalization with exposure to infection and a tremendous utilization of hospital services. With all these facts in mind the possibility presents itself of the advisability of performing a primary anastomosis with a thoracic stomach when the segments cannot otherwise be approximated with safety. This operation has been attempted in infants by Singleton and might be considered in suitable cases.

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STEIN-ESTLANDER-ABBE OPERATION

A Centenary in Plastic Surgery

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In Plastic and Reconstructive Surgery, Vol. 2, No. 4, Kazanjian has published an interesting article on "Estlander-Abbe Operation" in treating secondary harelip-deformities and defects of the upper lip resulting from cancer. In this paper he gives a historical note from which it appears that Estlander in 1877 was the first to shift a section of the upper lip to a defect of the lower lip utilizing the coronary arteries, and that Abbe in 1898 was the first to use a rotation flap from the lower lip to the retracted upper lip in harelip patients.

Perhaps it would be of interest to supplement this historical note with the information that probably the first operation of this kind was performed long before Estlander's time, as the Danish surgeon Professor Stein exactly 100 years ago, in 1848, published in Danish a "New Method of Cheiloplasty", in which he used the principle of replacing a defect of the lower lip with a rotation flap from the upper lip. His patient was a 48-year-old sailor with an extensive cancer of the lower lip. Excision of the tumor left a big V-formed defect which was closed by means of a double rotation-plasty from the upper lip, as appears from the original illustrations, which I have subjoined. The two vermilion-border-pedicles, which divided the oral orifice into a median cleft and two vermilion-border-surrounded openings, were preserved for 3 weeks; then they were cut through and the definitive suturing took place. No complication arose, apart from negligible suppuration, and the cosmetic result was satisfactory.

After this the method was used a few times by Danish surgeons, but it seems later to have fallen into oblivion, until the Finnish surgeon Estlander in 1865 repaired his first case of defect of one lip (after typhoid gangrene) with material from the other. He published his method in Germany in 1872 and in France in 1877, and by this means it entered the world literature and the text books. By his technique the rotation flap consists of a single big wedge of lip substance, including if necessary a part of the cheek; and as the blood-supplying pedicle consists of the vermilion border at the angle of the mouth the permanent oral orifice is reshaped at once, and the operation is a as rule completed in one stage.

As generally stated the American surgeon Abbe (1898) seems to have been the first to use the rotation flap principle to balance the lips in harelip patients with retracted upper lip and prominent lower lip.

Since then a rotation flap from one lip to the other has been increasingly used, partly after removal of malignant tumors (Blair, Moore & Byars), partly in traumatic defects (Gillies' fan flaps), and—in peace time—probably most often in secondary harelip deformities (Axhausen, Gillies & Kilner, Ragnell, Kazanjian). It is a very useful and satisfactory operation, which seems however to be

performed by some surgeons on rather wide indications It is certainly possible to attain a quite satisfactory result without a rotation flap in a number of cases, especially those whose lower lip is not very prominent, by means of sufficient mobilization, the components of the lip being first split up after excision of the scar, and finally accurate suturing in layers

In Denmark, where the surgical treatment of harelip and cleft palate is centralized through the State Institute for Defects of Speech to the Diakonissestiftelsen's Hospital in Copenhagen, the "Stein Estlander Abbe procedure" has, during recent years, been utilized with very good results in a series of selected cases of secondary harelip deformities

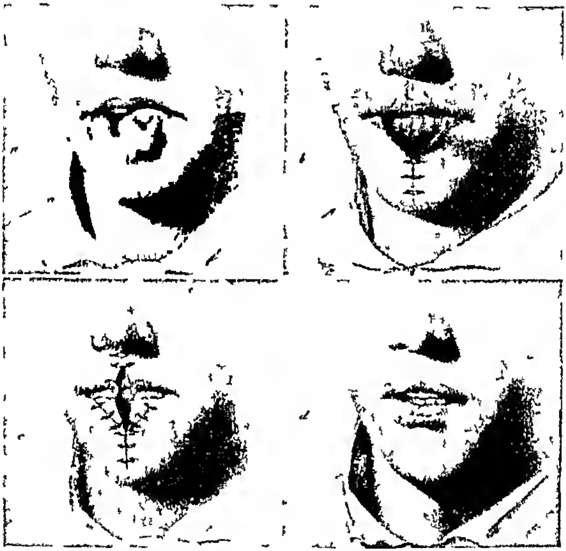

FIG I Illustrations from Stein s Danish article in 1848 Lipformation (Cheiloplasty), Performed after a New Method, by Prof Stein '

SUMMARY

The Danish surgeon Professor Stein was probably the first who performed an "Estlander Abbe operation " He published his method in Danish exactly 100 years ago, in 1848

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RADICAL EXCISION AND SKIN GRAFTING OF LEG ULCERS

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Chronic and recurring leg ulcers can be a disabling complication of a variety of pathological processes. In the past five years, the Plastic Surgery Service of Kings County Hospital has treated 33 chronic leg ulcers by the method which will be described in this paper.

The etiology of these ulcers was as follows:

Varicose veins	21
Compound fractures and/or osteomyelitis	5
Burns with unstable scar	3
Sickle Cell Anemia	2
Trophic (Nerve damage)	2
Total	33

It should be emphasized that these lesions represent cases which did not respond to the usual methods of therapy. The ulcers persisted despite local treatment with various substances, application of paste boots, and physiotherapy. Intensive surgical therapy had been employed for the underlying pathology, such as ligation and injection of varicose veins, and saucerization of the osteomyelitides.

It should also be noted that all the lesions presented in this series had been present for long periods of time, the longest having been present for 52 years, the shortest 2 months, whereas the average length of persistence was 10 years.

SELECTION OF CASES

The careful selection and pre-operative management of the patients contributed materially to the success of the procedure.

The arterial status in the affected leg was considered of prime importance. Determination of the adequacy of popliteal, posterior tibial and dorsalis pedis could be determined by palpation. In cases with faint or intermittent dorsalis pedis pulsation, oscillometry was resorted to and only those patients with a minimum variation of 2 to 2½ oscillations with the pressure cuff over the ulcer area, were selected. In some cases intravenous fluorescine dye studies were made but in our hands this method provided no additional information.

The age of the patient, chronicity, and size of the ulcer and its surrounding area of induration were factors which did not deter us in the employment of the

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Presented before the Clinical Congress of the American College of Surgeons, New York City, September 8–12, 1947.

procedure. The oldest patient was 75 years of age and the largest area which was excised on one leg was approximately 224 square inches.

For evaluation of the patient's general status, blood counts, serology, plasma protein determinations, and urinalyses were performed. Preoperative treatment consisted of high vitamin regime, split protein supplemental feedings, and transfusions of whole bloods. No procedure was undertaken until plasma protein and hemoglobin were at relatively normal levels.

TABLE 1

Varicose ulcers

CASE	AGE	DURATION	RESECTION	GRAFT	SIZE OF GRAFT	DISCHARGE	OCCUPATION	DATE	FOLLOW-UP COMMENT
		yr.			sq"				
M. C.	62	12	6-19-46	6-28-46	64	8- 7-46	Laundress	8-19-47	At work. Excellent result
M. D.	75	20	6-20-45	7- 6-45	32	8- 9-45	Housewife	8-18-47	Keeps house. Excellent result
B. F.	70	5	9-18-46	10- 4-46	64	11- 6-46	None	8-18-47	Veins never obliterated. Margins ulcerated and required reexcision June 1947. Fair results
J. G.	55	7	11-12-43	11-26-43	64	12-28-43	Cook and maid	8-18-47	Working. Excellent result
M. L.	52	2	9- 5-45	9-21-45	64	11- 5-45	Housewife	8-18-47	2 small areas of "no take" required regrafting this year. Good result
G. R.	67	$\frac{1}{6}$	5-14-47	5-21-47	32	6-14-47	Lab. worker	8-26-47	Excellent result
J. R.	57	1	12-18-46	12-27-46	64	1-21-47	Bus boy	6-21-47	At work. Excellent result
M. St.M.	56	27	1-26-44	2-18-44	32	3-21-44	Housewife	4- 4-47	Eczema of leg including graft. Fair result
M. W.	63	2	7-27-45	8-22-45	64	9-19-45	Housewife	8-19-47	Does housework. Excellent result
T. S.	53	5	1-11-47	1-29-47	128	3- 1-47	Seaman	8-19-47	Working. Good result

PATHOLOGY

The local tissue pathology in long standing ulcers is the same regardless of original etiology. The ulcer itself shows a pale necrotic base and hard indurated margins. Long standing ulcers often penetrate to the deep fascia and sometimes cause periostitis of tibia or fibula.

Indurated areas about the ulcer, and a hard indurated base indicate a barrier

of dense avascular scar tissue which interferes with the blood supply of the ulcerated area.

TABLE 2

Compound fractures and chronic osteomyelitis

CASE	AGE	DURATION ULCER	RESECTION	GRAFT	SIZE OF GRAFT	DISCHARGE	OCCUPATION	DATE	FOLLOW-UP COMMENT
					sq"				
A C.	42	30 yr.	3- 7-47	3-14-47	32	4-30-47	Waitress	7-21-47	Small area of "no take" needs a graft Fair result
H K.	58	7 mo	5- 3-44	5-26-47	32	6-25-44	House-work	8-19-47	Healed Does work Excellent result
J. M.	38	1 yr.	5-26-43	6-23-43	?	9-25-43	Factory		Amputation in 1944 For osteo
Unstable burn scar									
C St J	43	3 mo	6-13-47	7- 2-47	32	7-19-47	None	8-30-47	Healed excellent result
W C.	48	5 yr.	4-11-47	4-23-47 5- 7-47	192	6-14-47	None	8-18-47	Popliteal contracture cured Good result
Sickle Cell Anemia ulcer									
W B	37	10 yr.	9-21-45	10-17-45	32	11-20-45	Photographer	8-10-47	Recurrence at margins of graft Hemoglobin = 7 gm
R J	20	1½ yr.	6-13-45	6-27-45	32	8-13-45	None	8-10-47	Recurrence
Trophic ulcer (Poliomyelitis)									
G. H.	69	52 yr.	1-20-43	2- 3-43	69	3-10-43	House work		Amputation in 1944 Squamous cell carcinoma

The pathology of the discolored indurated areas surrounding the ulcer was found to be similar to that of the ulcer base. Changes included an obliterative endarteritis as well as chronic phlebitis in the vessels of the area, dense scar tissue formation and degrees of calcification in soft tissue and surface of bone.

OPERATIVE PROCEDURE

The rationale of this procedure is the removal of *all* dense, avascular scar tissue from the base and periphery of the ulcer and the replacement of the defect by split skin grafts.

Since the extensive resection of scarred skin and fascia is often a shock producing procedure and the subsequent grafting of these areas is time consuming it has been found expedient to do the procedure in two stages.

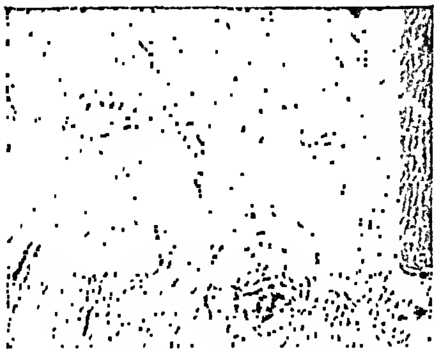

FIG. 1. AVASCULAR SCAR TISSUE FROM THE BASE OF A 5 YEAR OLD ULCER

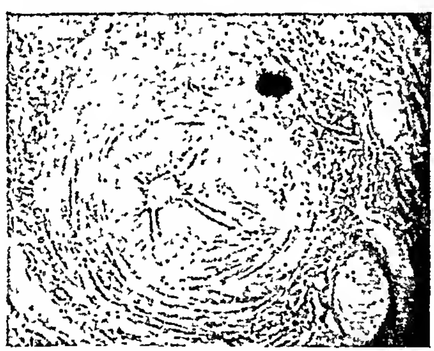

FIG. 2. ENDARTERITIS IN THE BASE OF A 1 YEAR OLD VARICOSE ULCER

The first stage (Excision), may be done under any type of anaesthesia except local infiltration which interferes with proper palpation.

With the patient anaesthetized, prepared and draped, the extremity and the operator's gloved hand are moistened with saline or sterile water. Finger palpation is gently done and any increase in resistance over that of normal skin and subcutaneous tissue is noted. The periphery of scarring is not considered to be reached until normal soft skin is palpated around the entire area.

Incision is made into normal skin completely—circumscribing the scarred area, and the incision carried down through the deep fascia. The circumscribed area is excised by dissection in the deep fascial plane so that only normal well

vascularized tissue remains This often necessitates carrying the dissection down to muscle and even periosteum or bone If the bone is sclerotic it is decorticated at this stage until free bleeding occurs After hemostasis is obtained

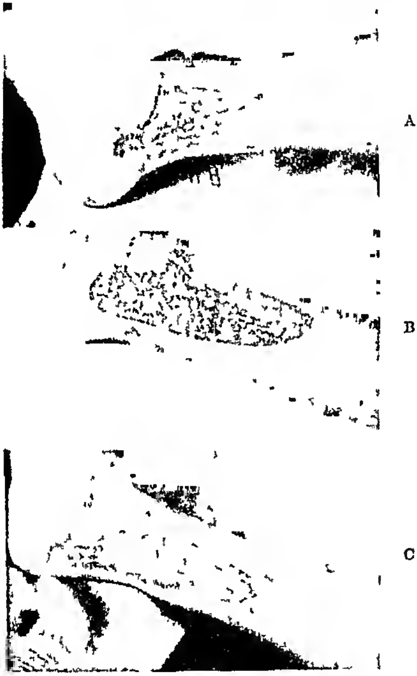

Fig 3a Varicose Ulcer of 2 Years Duration
Fig 3b Extremity Following Resection of Ulcer Base and Surrounding Scar
Fig 3c Extremity 2 Months after Grafting

the wound is dressed with a 70% Cod Liver Oil Ointment with moderate pressure, and a Plaster of Paris splint or cast is applied

In this series a period of 10 to 14 days was allowed between operations for granulation tissue to form, following which the second stage (Skin Grafting) was performed

In all cases, split skin grafts for complete coverage, were taken from appro-

priate areas by means of the Padgett Dermatome. These grafts were sutured into place with interrupted and continuous sutures of silk and dressed with Furacin ointment, pressure dressings and again a plaster of Paris splint or cast was applied.

A

B

C

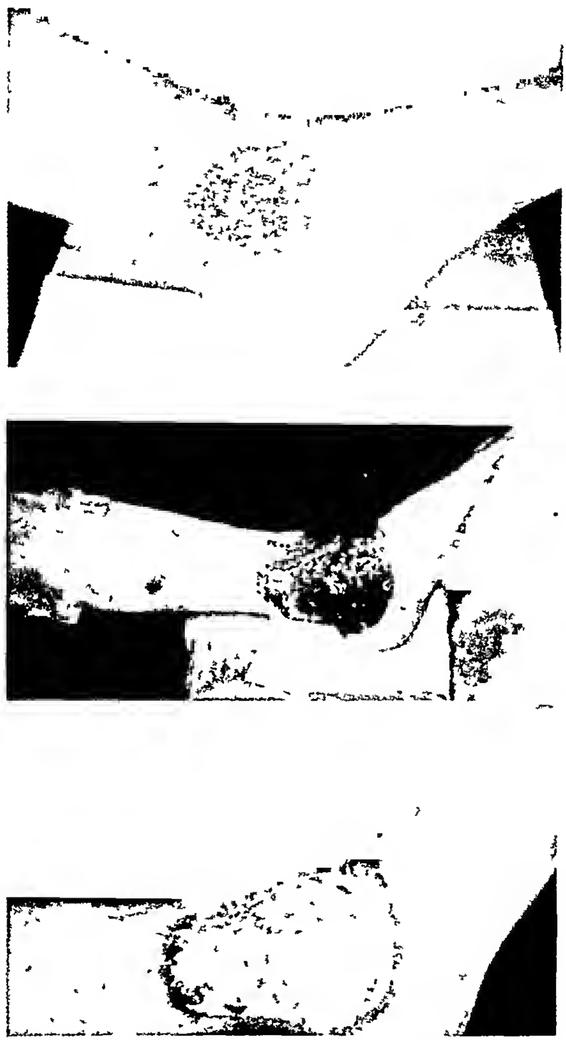

FIG. 4a. VARICOSE ULCER OF ONE YEARS DURATION
FIG. 4b. EXTREMITY FOLLOWING COMPLETE EXCISION OF SCAR
FIG. 4c. LESION TEN DAYS AFTER GRAFTING

DISCUSSION

Excision and grafting of leg ulcers is not a particularly new procedure. Owens in 1937 recommended excision and split grafting. Rees and Slevin more recently have used excision and Reverdin grafts. Our emphasis in this paper has

been on complete and radical excision of all avascular tissue, be it skin, fascia, periosteum or bone and its subsequent complete coverage with split grafts.

In several cases of varicose ulcers in which the venous pathology had not been adequately eradicated, marginal ulcers appeared and had to be treated exactly


A
B
C

FIG 5a. UNSTABLE SCAR DUE TO BURN ULCER OF 5 YEARS DURATION
FIG. 5b and c. EXTREMITY 6 WEEKS AFTER GRAFTING 192 SQ INS OF SKIN

as the original In one case of ulcer due to osteomyelitis the recurrence of the osteomyelitis caused partial breakdown of the grafted area, while in both cases of Sickel Cell Ulcers, the underlying pathology remained and ulcers recurred.

Vitamin therapy, maintenance of Plasma protein and hemoglobin, and observance of the basic tenets of skin grafting, i e, clean wounds, adequate pres-

sure, and immobilization of the grafted parts, were factors which could not be overlooked if success were desired.

CONCLUSION

A method of treatment of chronic leg ulcers by radical excision and split skin grafting has been presented. This method has proved to be very effective in the correction of varicose ulcers and ulcers due to old burn scars. Success in the treatment of ulcers due to osteomyelitis of tibia or fibula is dependent upon the complete and permanent elimination of the underlying osteomyelitis. Success in the treatment of trophic ulcers is limited because of the persistence of the same factors which caused the ulcers originally. In Sickle Cell Anemia, the ulcers recur due to the inability to eliminate the pathology of the disease.

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TENDON TRANSFER TO RESTORE ABDUCTION OF THE INDEX FINGER USING THE EXTENSOR POLLICIS BREVIS

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The first dorsal interosseous muscle, sometimes called the "abductor indicis" is the most important of the seven interosseous muscles of the hand Loss of function of this muscle may result from local injury, following which adduction deformity of the index finger ensues In ulnar nerve lesions there is often complete atrophy of this muscle, its position on the dorsum of the hand being represented by a deep hollow between the first and second metacarpals In such hands, there is marked weakness of pinch due to a lack of stabilizing action by the abductor of the index finger Although strong flexion of the thumb and forefinger are present, the latter is pushed by the thumb into ulnar deviation at its proximal joint

Bunnell, in his textbook "Surgery of the Hand," has described an operation to furnish abduction of the index finger utilizing the tendon of the extensor indicis proprius, which is detached near its insertion, lengthened with a short tendon graft and inserted into the lateral tubercle on the radial side of the proximal phalanx of the index finger Graham has described a tendon transfer for the same purpose using the sublimis flexor tendon of the ring finger

The purpose of this paper is to describe a method of tendon transfer employing the short extensor muscle of the thumb The advantages of this operation are that the short thumb extensor muscle has a good direction of pull, very similar to that of the muscle it replaces, it is readily available and its use does not result in serious functional loss to the thumb, provided the long extensor muscle is intact

A short transverse incision is made over the dorsal surface of the metacarpophalangeal joint of the thumb The tendon of the short extensor is severed at its insertion into the base of the proximal phalanx, taking care to preserve all possible length A second short incision is made over the proximal end of the "anatomical snuff box", avoiding injury to the radial nerve The tendon is freed and withdrawn to this point It is then re routed subcutaneously under the tendon of the long extensor of the thumb, toward the insertion of the first dorsal interosseous muscle, over which a third short skin incision is made The surface of the tendon of the short extensor is roughened and it is then woven back and forth through the tendinous portion of the first dorsal interosseous muscle near its insertion Fixation is obtained by means of a single pull out suture of No 34 stainless steel wire (fig 1) An alternative to the above technique is to withdraw the short extensor tendon to the proximal end of its fibrous tunnel, thus gaining additional length

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Following surgery, the hand and forearm are put up in an anterior molded plaster splint, with an extension of the plaster to hold the proximal joint of the index finger in slight abduction. Physiotherapy is started in three weeks with caution against strong ulnar flexion of the index finger until after six weeks.

It is obvious that the proximal joint of the index finger must have free lateral motion to obtain success. If the joint is stiff, capsulectomy may be necessary, but even then a perfect result cannot be expected. Likewise, it is evident that the short extensor muscle of the thumb must be intact. A good preoperative test is to have the patient spread out his hand as if he were attempting to reach

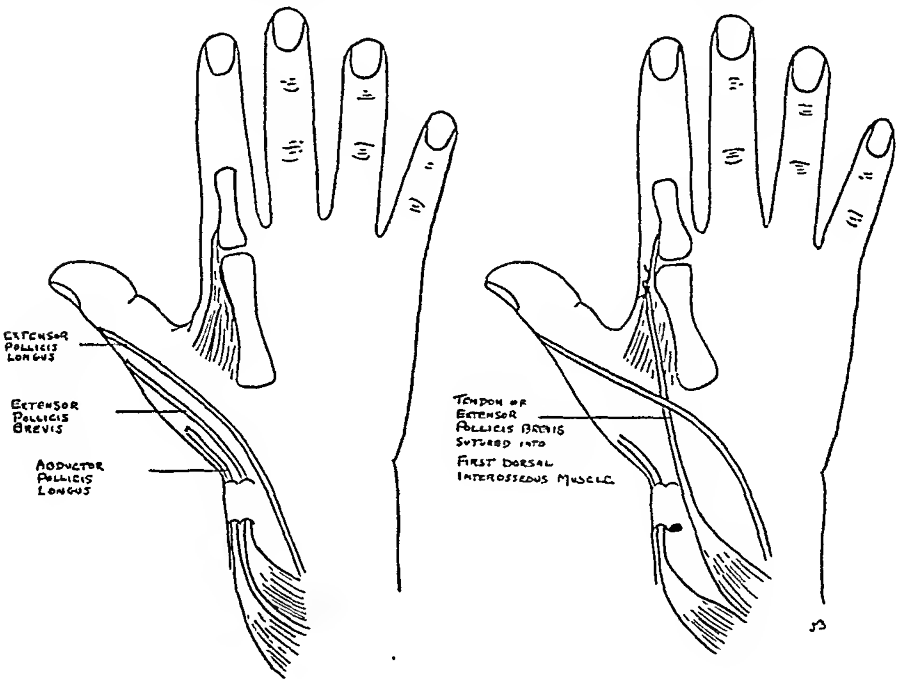

FIG. 1

a "tenth" on the piano keyboard. This extreme abduction of the thumb demonstrates the strength of the muscle and the size of its tendon.

Indications for this operation include cases of local injury to the first dorsal interosseous muscle, and ulnar nerve lesions where motor recovery is doubtful. In the latter case, it may be combined with other procedures to restore function of other intrinsic muscles supplied by the ulnar nerve. These include the tendon loop and tendon T operations to restore adduction of the thumb, and the operation to restore function of the interosseous muscles, using slips of the sublimis tendons as described by Bunnell.

Several such cases of tendon transfer, using the short thumb extensor, were done by the author at Army Hand Centers in 1946 (figs. 2, 3, & 4). The indication in all cases was atrophy of the first dorsal interosseous muscle from

FIG 2 Case V H (McCornack General Hospital) Ulnar nerve lesion in hypothenar area Good abduction of index finger following tendon transfer of extensor pollicis brevis (Post op photo)

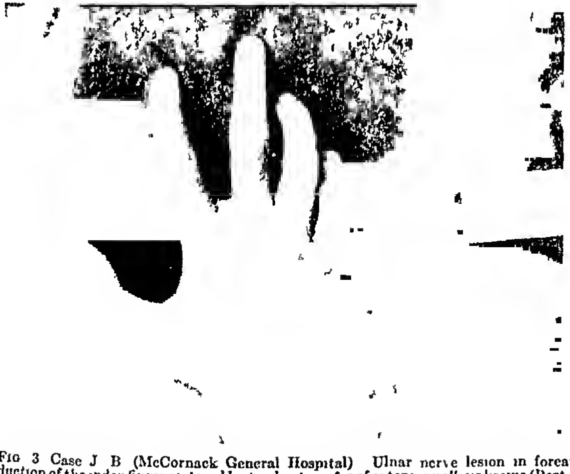

FIG 3 Case J B (McCornack General Hospital) Ulnar nerve lesion in forearm Abduction of the index finger restored by tendon transfer of extensor pollicis brevis (Post-op photo)

ulnar nerve injury. In each case, ulnar nerve suture or repair had been undertaken but motor recovery was considered unlikely because of the lapse of considerable time, with consequent fibrosis of muscle tissue. Patients in this group were observed from two to three months following surgery, and all obtained satisfactory voluntary abduction of the index finger.

To summarize, it may be said that three tendons are available to restore abduction of the index finger: the extensor indicis proprius, the flexor digitorum sublimis, and the extensor pollicis brevis.

FIG. 4. Case A. W. (Wm. Beaumont General Hospital). Ulnar nerve lesion from bullet wound in hypothenar area, left hand (nerve to abductor digiti quinti spared). Post-operative photo shows abduction restored to index finger following tendon transfer of extensor pollicis brevis. Bunnell tendon T operation was also done.

The extensor indicis proprius has been recommended by Bunnell, in cases of local injury to the first dorsal interosseous muscle. The flexor sublimis of the ring finger has been advocated by Graham, and is especially useful for those cases where a muscle and tendon of considerable strength are needed to overcome ulnar deviation of the index finger due to scar contracture.

The extensor pollicis brevis is suggested especially in ulnar nerve lesions where recovery is doubtful. Its use is not disabling, it has a favorable angle of pull, it is long enough to be used without lengthening by graft, and it is strong enough to restore useful abduction of the index finger. The use of this tendon

transfer in combination with other tendon transfers to restore function of the intrinsic hand muscles is well worth while and when indicated, should be undertaken more frequently.

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CANCELLOUS BONE GRAFTS FOR RESTORATION OF NASAL CONTOUR

BRUCE C. MARTIN, M.D., Lt. Col., M.C., Inactive

For some time we have used cancellous bone for reconstruction of nasal contour in cases where deficiency is rather marked and good support is needed. More recently we have extended its use to cases where the defects have been smaller.

At the present time we are able to present a series of fifteen cases where defects are of multiple etiology. By far the greatest number have been the result of trauma, war injury or otherwise. Six of these cases were war injuries. Four of the six presented the problem of openings into the nasal chambers. One of these cases could be closed with local tissue while the remaining three required pedicle tissue.

Of the remaining nine cases, seven were the result of civilian type injuries; namely, automobile accidents, or blows. On the two remaining cases the history was rather vague as both occurred in childhood—one following an operation.

In this series of cases there were no failures. One case presented the picture of an acute fulminating infection which subsided promptly with drainage and chemotherapy. Surprisingly enough the graft survived. This patient had had two homologous cartilage grafts with failure several months before. In one case the strut portion of the graft became exposed thru the columellar incision. The exposed portion was removed with a roungeur and the wound secondarily closed with prompt healing. In one case autogenous cartilage had been placed in the nose fifteen years before but had badly warped. It was removed and bone graft inserted at the same time.

METHOD

We have used the midcolumella incision in most cases. In our opinion this method gives the best exposure of the dorsum of the nose and the nasal spine of the maxilla. We feel that if a strut is needed for support of the nasal tip it should be placed directly against the nasal spine. This incision enables us to dissect an adequate pocket for the strut. In undermining the dorsum of the nose we attempt to stay beneath the periosteum. An iliac crest is exposed and the cortical portion elevated with a saw. An appropriately sized block of cancellous bone is removed and shaped. A groove is placed in the posterior surface near the distal end of the graft which overlies the dorsum of the nose. This graft is seated properly in the bed on the nasal bones. The tip of the graft is elevated to the desired height and the length of the strut necessary is estimated. The strut is then cut off and fitted into the groove. The incision is closed and mattress sutures placed thru the columella and tied over lead plates to relieve any tension. Immobilization is effected by light nasal packing and a nasal

splint formed from lead plates. The grafts are usually secure in ten to fourteen days.

We feel that cancellous bone grafts are superior to autogenous cartilage in the following respects. They are more easily secured. The site of the scar is well hidden—a definite factor in females. These grafts are readily shaped and show no tendency to buckle or warp. They are more resistant to infection. This

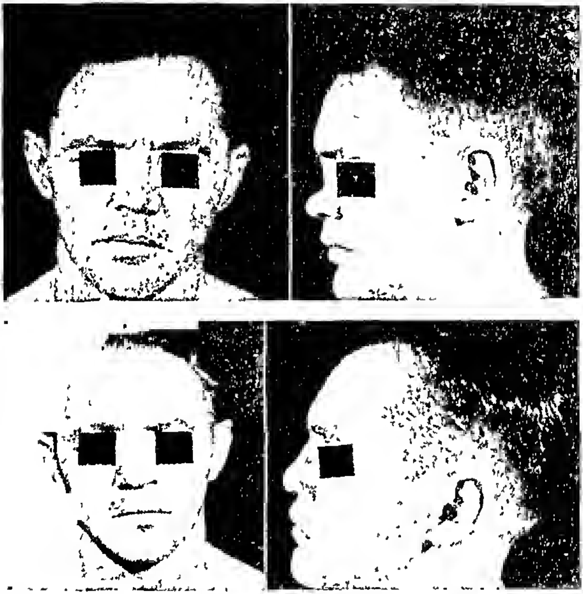

Fig. I. A (upper left) and B (upper right): Condition followed childhood injury and infection. C (lower left) and D (lower right) After bone graft

latter fact has been demonstrated repeatedly in grafts to the mandible, zygoma and orbit. Furthermore, these grafts vascularize very readily. We have a series of biopsies from 25 days postoperatively up to eight months. The earliest biopsies show definite vascularization and decalcification along with laying down of new bone. This process is rather marked even in this short period of time. After a period of about six months the outer surfaces of the graft have begun to assume a cortical appearance, both grossly and microscopically. We feel that this early vascularization is a great factor in the success of these grafts.

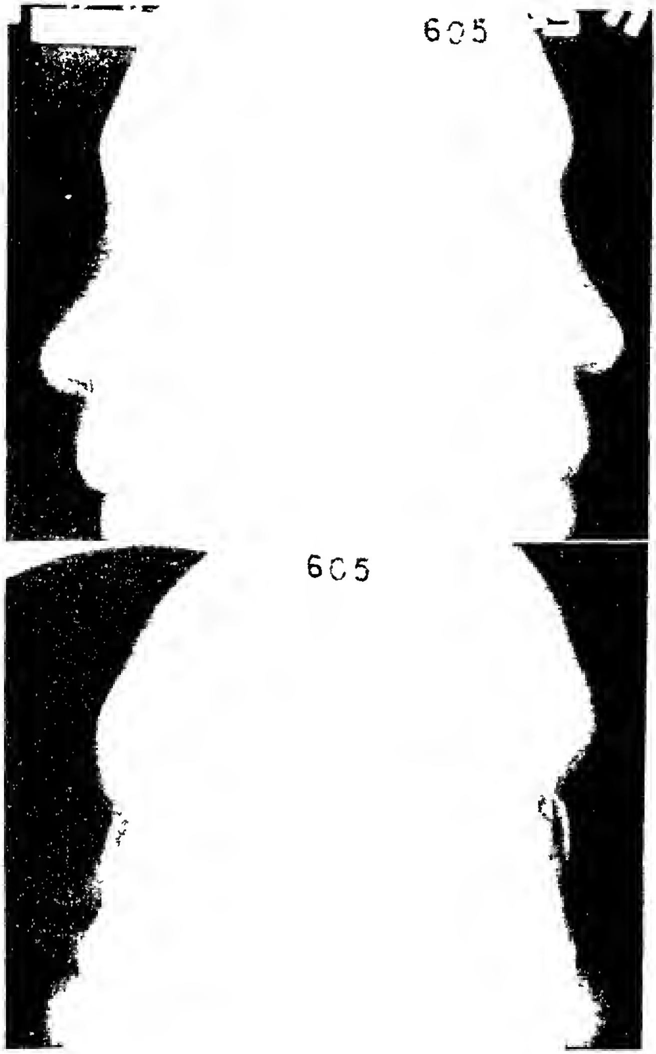

FIG. II. A AND B: X-RAYS OF PATIENT SHOWN IN FIG. I

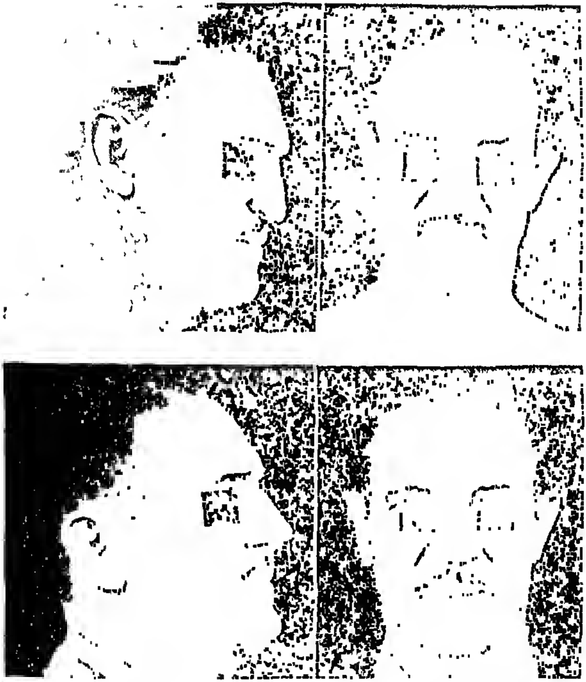

Fig. III [illegible] t) Autogenous cartilage transplant had been [illegible] nd D (lower right). Postoperative condition [illegible] bone graft inserted.

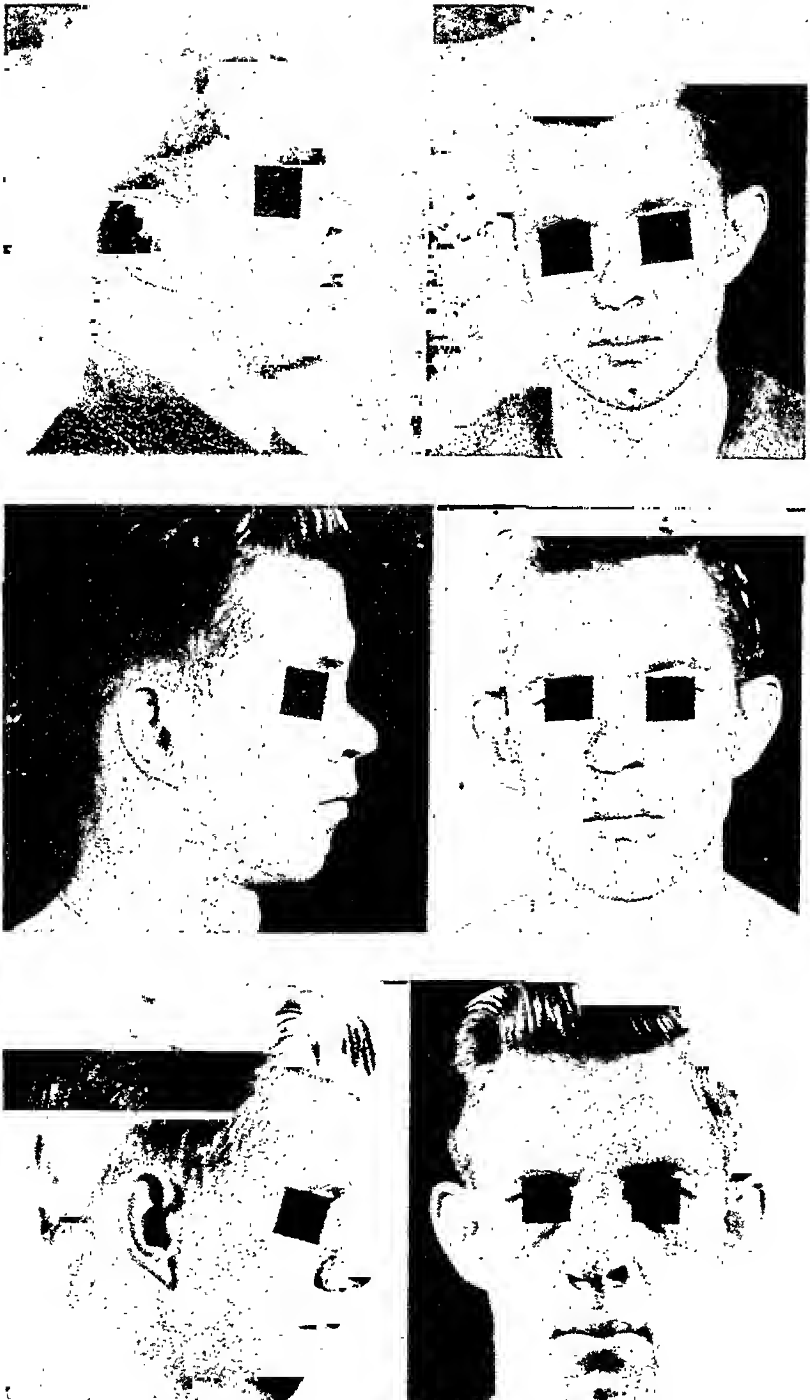

FIG. IV. A (upper left) and B (upper right): Penetrating shell fragment wound. C (center left) and D (center right): Fistula closed by infracture of nasal bones. E (lower left) and F (lower right): Bone graft later.

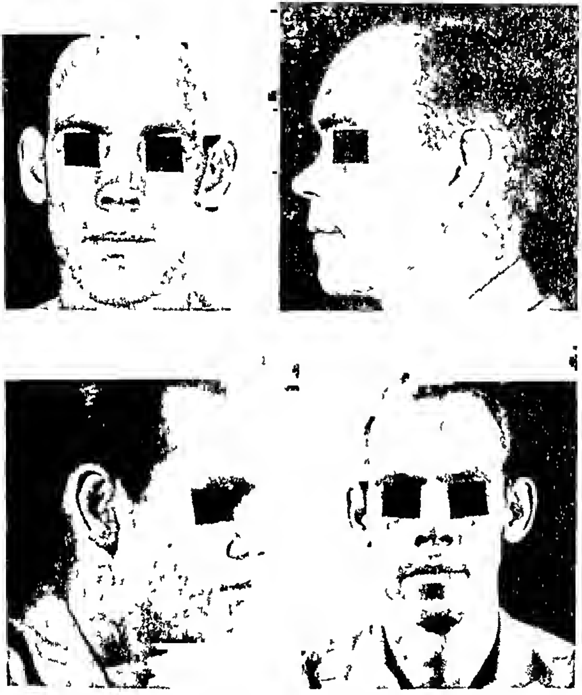

FIG V A (upper left), B (upper right) C (lower left) and D (lower right) Depressed nasal fracture Nose was narrowed by infracture Bone graft eight weeks later

SUMMARY

1. Fifteen consecutive cases of cancellous bone grafts to the nose have b presented. The deformities have been results of war injuries, civilian injur and infection.

2. In one case in which two previous homologous cartilage grafts hadfail there was acute infection. The bone graft survived.

3. The writer feels that cancellous bone is superior to autogenous or hom ogous cartilage.

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EARLY MAXILLO-FACIAL SURGERY, WORLD WAR II

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It has always been recognized that the success of traumatic surgery is influenced by the time that elapses from injury to operation. In an effort to carry out this premise in combat, the United States Army Medical Department utilized mobile surgical teams to augment the medical installations The plan was designed so that mobile teams and their equipment might be sent from unit to unit to operate wherever casualties were the greatest. Almost from the moment of injury, the soldier received medical attention. Company Aid Men were constantly ready for immediate emergency care by controlling hemorrhage, applying splints, bandages, dressings, and administering sulfa and morphine. These heroes, with no medical training other than that given by the Army, followed the line and went beyond the line, always unarmed By their untiring efforts under fire, the injured were brought back for further treatment. But for the work of these Aid Men and the Battalion Surgeons immediately behind them, countless numbers of American soldiers might never have returned.

At the Battalion Aid and Collecting Stations further emergency treatment was available. Bandages were changed, splints adjusted, and more medication was given. Here also, the triage of the wounded was begun. At these points, information was available about the surgical specialty teams and where they were operating. Neuro-surgery and Orthopedic surgery cases were sent to the —— Field or Evacuation Hospital because these installations had surgical teams equipped to handle such cases. Thoracic and Abdominal cases were sent to the —— Field or Evacuation Hospital and so on. Maxillo-facial Plastic cases were triaged in the identical manner.

These surgical teams belonged to no hospital. They comprised their own unit although they were never "at home." In the United States Third Army such a unit was the 4th Auxiliary Surgical Group. Other similar groups functioned in Africa and Italy with other American armies. All the surgical groups served to augment each other when required. The 4th Auxiliary Surgical Group, as the other groups, was composed of 180 enlisted men, 78 nurses and 132 officers. The unit was set up in groups of teams and then broken down into individual teams approximately as follows:

Orthopedic teams	12
Neurosurgery teams	10
Maxillo-facial plastic teams	4
General surgery teams	20
Thoracic surgery teams	15
Shock teams	12
Dental prosthetic teams	3
Total	76

Each team was provided with equipment, instruments, and an anesthesia kit. A team's personnel usually comprised two medical corps men, two nurses and two officers as surgeons. Our team, like the other three maxillo-facial teams, was composed of a Major, M.C. as plastic surgeon and a Major, D.C. as oral surgeon, two nurses, two corps men and all the required equipment.

From Normandy to Germany, teams were sent from one installation to another depending upon the need of that team's type of surgery. Orders to move might come at any time, day or night, and then instruments and equipment were packed, tents were struck and the team moved on to a more forward installation. Each hospital had its own regulations and procedures but the new teams had to go to work without any time to "break-in" to the new routine. Supplies and mail had to come from the 4th Auxiliary Surgical Group Headquarters which might be 3 or 300 miles away. A team might be shifted several times before headquarters could locate the "lost" team and mail was delayed many weeks. The fluidity of the tactical situation required extremely mobile surgical teams. "In the European and Mediterranean Theaters, hospitalization units of field hospitals, supplemented with auxiliary surgical teams, most frequently served this purpose (of bringing surgery up close to the line—author). In many cases, clearing companies and evacuation hospitals, augmented by surgical teams, performed front-line surgery. This new concept of bringing the surgeon to the seriously wounded soldier rather than the critically injured to the surgeon was responsible, more than any other factor, for the phenomenally low rate of death from injury in this war."[1]

Perhaps the only objection to this work was the inability to follow a case. After operation, only 3 or 4 days would be allowed for post-operative care and observation. Cases had to be evacuated soon after this for more definitive care. In addition, early evacuation was urgent to make room for other wounded. Thus, the short post-operative course sometimes resulted in an inaccurate impression about the prognosis of these injuries. The repair of a severe avulsion of the face was very dramatic. To a casual observer, if the operation was an improvement over the injury, the result was expected to be excellent especially when there was no information on the follow-up of these injuries. We never really knew how much tissue sloughed, how many sutures pulled out or how frequent was the incidence of infection. To us, post-operative complications were "unknown." All our cases were "perfect." The real comment on first definitive surgery, must now come from those tireless surgeons in the plastic centers who operated repeatedly to obtain the results we hoped for in initial surgery.

In the mechanism of war injuries, there are many influencing factors. The most important of these are the size, speed and motion of the missile in its flight. After entering a part, the variation in density of the structures traversed by the missile will also affect the injury. The size of the missile will determine the size of the wound. The speed of the missile will determine the depth of the wound. The motion of the missile may be straight head-on like a rifle bullet

[1] Bulletin of U. S. Army Medical Department, Vol. VII. No. 6. June 1947. p. 541.

or it may be revolving head over heels as a shell fragment The latter is obviously more destructive Further, when a missile encounters a part of greater density, such as bone, the impact results in an explosion From the center of this point, numbers of new 'missiles' (bone fragments missile fragments, teeth, filling material, etc,) fly in all directions Each new missile is now a destructive force in itself The magnification of the original explosion is tremendous and its effect is readily seen when one encounters the small point of entry and the large point of exit in these injuries

For the type of anesthesia available, we had intravenous Pentothal, Nitrous Oxide Oxygen Ether by Endotracheal Intubation or Regional Block Almost all of our cases were operated on under Regional Block Intravenous Pentothal entailed certain serious drawbacks It is not an anesthetic but a barbiturate (hypnotic) administered in massive doses thereby being pushed to anesthetic levels where it becomes a severe respiratory depressant (The most successful use of Pentothal to day is in conjunction with Nitrous oxide Oxygen) It was also found that under Pentothal, the laryngeal reflexes were not obtunded In fact, they became hypersensitive to such an extent that the slightest droplet of mucus, blood or a small foreign body would set up a violent laryngospasm which would cause great concern Injured soldiers frequently were helpless and exposed to the elements for long periods before being picked up, and upper respiratory infections were common in the line The presence of a post nasal drip alone would be sufficient to start a laryngospasm under Pentothal As far as Nitrous oxide Oxygen Ether by Endotracheal Intubation was concerned, we found it very difficult to induct a patient and at the same time prevent the aspiration of blood, mucus or foreign bodies prior to passing the tracheal tube In addition, these patients usually had a stormy post operative course with vomiting and distention to such a degree that a nurse was required for constant attention until complete reaction from the anesthetic When wards were over filled, the care of post operatives could not be all that was desired because of the shortage of nurses and beds Consequently, Regional Block became the anesthesia of our choice almost from the very beginning Patients were operated upon on the flat operating table with routine cleansing and sterilization with paint, followed by sterile drapes Those who had any respiratory embarrassment were propped up in a semi sitting position for easier breathing Extra oral blocks of the various branches of the Fifth nerve and the Superficial Cervical plexus and its branches became the chief method of anesthesia in almost all of our cases The premedication consisted of Morphine gr $\frac{1}{4}$ and Atropine gr $\frac{1}{150}$ intravenously about ten minutes before operation The post operative course was seldom of any concern The normal laryngeal sensitivity eliminated aspiration It was not necessary to perform a tracheotomy on any case either before, during, or after operation Cases were followed closely for the short time allowed and if the patient was comfortable with no respiratory difficulties, he was evacuated In all fairness, it is impossible to say that no tracheotomy was required after evacuation but we took great precautions to evacuate only those who could travel in comfort

There have been many classifications of maxillo-facial injuries. We found that these cases fell into one of two general classes. Either sufficient viable tissue was available for a closure with good cosmetic result or there was insuf-

FIG. 1 "GUTTER" TYPE WOUND WHICH SEVERED THE SUPERFICIAL TEMPORAL VESSELS

FIG. 2. WOUND CLOSED WITH RUBBER DRAINS AT EACH END

ficient viable tissue and a skin to mucous membrane closure was required. While a skin to mucous membrane closure produces a very poor cosmetic result, at least the adjacent tissue is preserved for future use in plastic surgery procedures. If a large maxillo-facial injury is merely debrided and not closed, considerable

sloughing will follow so that the resultant defect becomes much larger than the original wound and the plastic procedure is much more difficult.

The following group of cases demonstrates the type of injury in which suf-

FIG. 3. WOUND INVOLVING THE NOSE, UPPER LIP, MAXILLA, NASAL AND ORAL CAVITIES

FIG 4 CLOSURE WITH SKIN SUTURES MUCOUS MEMBRANE SUTURES IN THE NASAL AND ORAL CAVITIES VASELINE GAUZE PACKS IN THE NASAL CAVITY

ficient viable tissue was available for a direct closure after minimum debridement. Fig. 1, shows a gutter-type wound of the Temporal area which required ligation of the Temporal vessels before surgery. After debridement, the closure

was completed and drains were inserted in the extremities of the wound as in fig. 2. Fig. 3, shows an avulsion of the nose, maxilla and lip, involving the oral mucosa and the nasal cavity. Fig. 4, shows the closure with sutures in the

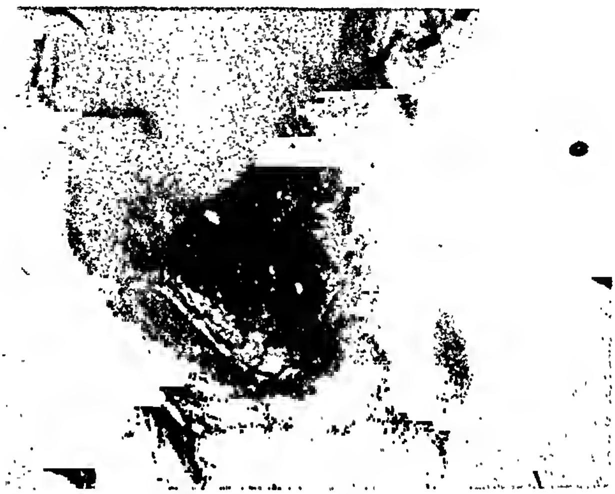

FIG. 5. AVULSION OF THE LEFT SIDE OF THE FACE. NOTE THE WOUND OF ENTRANCE IN THE RIGHT SIDE OF THE NECK

FIG. 6. CLOSURE WITH RUBBER DRAINS IN PLACE

nose to close the nasal mucosa and vaseline gauze as a nasal packing to reduce scar formation. Fig. 5, demonstrates a typical injury with the small entrance wound in the right side of the neck at the level of the Thyroid cartilage and the large exit wound in the left side of the face. The mandible was shattered and the

External Maxillary vessels had to be ligated Fig 6, shows the repair Deep fascia sutures were placed to reduce the dead space and small skin sutures were placed to close the defect Note the rubber drains for dependant drainage

FIG 7 AVULSION OF THE LEFT SIDE OF THE FACE NOTE THE WOUND OF ENTRANCE IN THE RIGHT NASO LABIAL FOLD

FIG 8 LATERAL VIEW OF THE WOUND OF EXIT

Fig 7, shows the small entrance wound in the right nasolabial fold and the large exit wound in the left side of the face Fig 8 shows the extent of the avulsion and a fragment of remaining mandible in the center of the wound The mandible was fixed by use of an arch wire as in fig 9, and the wounds were closed and

drained as in fig. 10. Fig. 11, shows an avulsion of the middle third of the face involving the maxilla and the nasal cavity. The breathing tube was fixed in place by the aid man at the time of injury to insure a patent airway during

Fig 9 Arch Bar Applied to Stabilize the Mandible

Fig. 10 Wound of Exit Closed with Rubber Drains in Place

transportation for surgery. Fig. 12, shows the repair and the packing in the nose.

When there was actual loss of tissue, some defects could not always be closed by simply bringing together the skin edges unless the location of the wound permitted the use of relaxing contra-incision and/or sliding flaps. Where these

were not feasible, the only alternative was a direct skin to mucous membrane closure with the utmost regard for the cosmetic result Unfortunately the cosmetic result in these cases was very poor but the loss of tissue allowed no

Fig. 11 Avulsion of the Middle Third of the Face Involving the Nasal Cavity, Maxilla and Right Antrum The Emergency Breathing Tube Was Inserted to Avoid Respiratory Embarrassment while being Transported for Surgery

Fig 12. Closure of Fascia and Skin Nasal Packing Inserted

other choice in our hands. Should this not be done and the wound simply debrided and left open, then considerable slough follows and good tissue is lost, thus complicating the later repair. Fig 13, shows an oblique injury with loss of full thickness tissue. Fig. 14, shows the skin to mucous membrane closure.

Fig. 15, shows a large defect with loss of the symphysis, half of the tongue and cheek tissue. By relaxation and rotation of the skin a closure was obtained as

FIG. 13. OBLIQUE AVULSION OF THE FACE INVOLVING THE NOSE, MAXILLA AN CHEEK WITH FULL-THICKNESS LOSS OF TISSUE

FIG. 14. ORAL AND NASAL MUCOSA EVERTED FOR A SKIN TO MUCOUS MEMBRANE CLOSURE

in fig. 16. Fig. 17, shows a similar case of loss of substance. Fig. 18, shows the repair and the arch wire attached for mandibular fixation.

For immobilizing the mandible, multiple intra-maxillary wire loops and intermaxillary elastics for traction were used. Slices of the small-bore latex rubber

tubing used in transfusions were used as elastics. As a precaution, all immobilized cases were provided with emergency rip-cords These were heavy black-silk suture material passed through each elastic and tied in long strands to hang out of the corner of the mouth In case of vomiting during evacuation, the

FIG 15 ANTERIOR VIEW DEMONSTRATES THE EXTENT OF THE WOUND

FIG 16 CLOSURE BY ROTATION OF THE SKIN

patients were instructed to pull the rip-cords and thus quickly remove all the elastics so as to open and empty the mouth

Local-regional anesthesia was used in almost all cases Adequate anesthesia was provided by extra-oral blocks of the branches of the Fifth Nerve and the

Superficial Cervical Plexus, using Procaine 2% with adrenaline—three drops to the ounce (1:150,000). Suture material was very fine black silk which was used for buried fascia sutures, ligation of vessels and skin closure. Buried silk

FIG. 17. AVULSION OF THE LOWER THIRD OF THE FACE INVOLVING THE SYMPHYSIS AND THE TONGUE

FIG. 18. CLOSURE BY ROTATION OF THE SKIN. ARCH BAR FIXED TO THE LOWER TEETH TO STABILIZE THE BODIES OF THE MANDIBLE

sutures become encapsulated and need not be removed. Rubber tissue drains were placed for drainage and vaseline gauze was used for nasal packing. Debridement was always conservative and the only bone which was removed was that which had no periosteal attachments.

MORTALITY

Of a series of 1169 cases, three cases expired. One case was fourth degree burns of the entire body. Another case had an associated fractured skull with extensive brain damage. The third case arrived with a severed Common Carotid Artery and Internal Jugular Vein, and expired thirty-two hours after ligation

The great vascularity of the area of maxillo-facial injuries, the routine use of sulfa and Penicillin and the fortitude of the patients were all significant factors Equally important was the aid and attention given by the over-worked nurses who carried on their duties so wonderfully. In retrospect, the initial purpose of early definitive surgery was achieved.

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A POINT-EYED SUTURE SET

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Needles with eyes in the points give the surgeon an advantage in placing certain sutures. The desire to meet this requirement is shown by the many point-eyed suture instruments which have been invented. A few of these are: the Reverdin needle, tonsil suture needles by Dupuy and Weiss, MacCuen and Smith, Goddard, Durham, and Hurd. The Blair-Brown fascia needle, and Mayo ligature carrier are answers to the same demand.

Among the recent instruments to employ detachable needles are the Singer instrument described by Goodman in 1942[1], and the Vim-Ogburn surgical stitcher. These instruments have not come into as wide use as the demand for point-eyed suturing warrants. They are well-known and available but relatively few surgeons use them.

To meet the need for a point-eyed suturing instrument, and to avoid the objections which have limited the use of the recent inventions, a suture set was assembled which is inexpensive enough to warrant its purchase for even occasional use. It is extremely simple in operation, and is delicate enough to be used in suturing the eye, or for hare-lip and cleft palate work. It uses easily replaceable needles, and is adaptable to an unprecedented variety of situations.

The outfit consists of two chuck handles, a sharp-pointed thumb forceps, and an assortment of point-eyed needles. The handles are about the size of a pencil and have the familiar chuck jaws, tightened by a screw collar. One has four parts and contains a reel of suture material in the shaft. The other handle has only two parts but has the same use as the other except that it has no self-contained suture supply. The needles have one eye near the point.

In use the curved needles are threaded from the convex side, the short end of the suture being on the concave side. In making a simple interrupted stitch the needle is passed through the tissue to be united and slightly withdrawn to make a slack in the short end of the suture. This is grasped with the thumb forceps or caught with a hook held in the other handle, the needle is withdrawn, and the suture tied and cut, or cut to be tied later. The needle is simply inserted and pulled out and never released. This is in contrast to the multiplicity of motion in conventional suturing, where the needle is pushed through the tissue, released, grasped at the forward end, released, and grasped again at the base.

A mattress suture can be placed by passing the needle as for two stitches before cutting the suture on the far side of the wound. Chain continuous sutures are easily made, after a little practice, by grasping the thread on top of the needle through a loop of the previous stitch.

Presented before the American Society of Plastic and Reconstructive Surgery, October 21, 1947.

[1] Goodman, Henry I.: A New Surgical Suturing Instrument With a Continuously Threaded Needle. J. A. M. A. 120: 281–283 (Sept. 26) 1942.

The usefulness of the instrument is outstanding where many interrupted sutures are to be placed, as in a split, or full thickness skin graft, or a long skin incision.

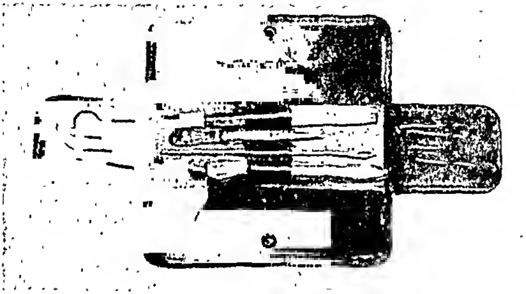

FIG. 1. POINT-EYED SUTURE SET

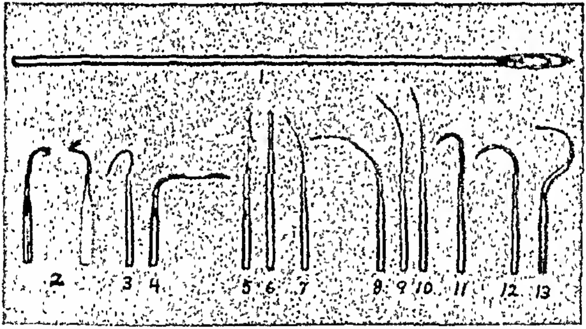

FIG. 2. SOME OF THE USEFUL INSERTS FOR THE CHUCK HANDLE
1. Ligature carrier. 2. Right and left palate or septum needles. 3. Septum needle. 4. Needle for upper lateral nasal cartilages. 5. Transfixation needle 6. Drill. 7, 8, 9, and 10. Skin needles. 11 and 12. Hooks 13. Tonsil, anterior ethmoid or sphenopalatine needle.

In suturing the cornea, if fine suture material is used, the trauma from the doubled strand is much less than that caused by releasing and then grasping a needle lying in the tissue. It is difficult not to rock the needle and tear the tissue in releasing and grasping with the needle holder. In corneal operations it is adapted to the placing of a suture across the line of a proposed incision in order to make the realignment of the edges accurate.

In suturing a cleft palate or uvula the curved needle with its axis at right angles to the shaft avoids the difficulties of releasing and grasping a needle while working in a small space with fragile and mobile tissue. The point-eyed needle has an advantage in placing sutures in perforated metal ribbons used in palate repair.

The repair of fractures of the facial bones by drilling and wiring is accomplished by the use of a drill tip which fits the handle and quickly makes a hole in the bone by rotating with the wrist. The drill has a fan-tail tip with the two halves of the end meeting at a slight angle and beveled to sharpness on opposite sides. A wire can be drawn through the hole after engaging in a loop of thread placed through the hole by a straight point-eyed needle.

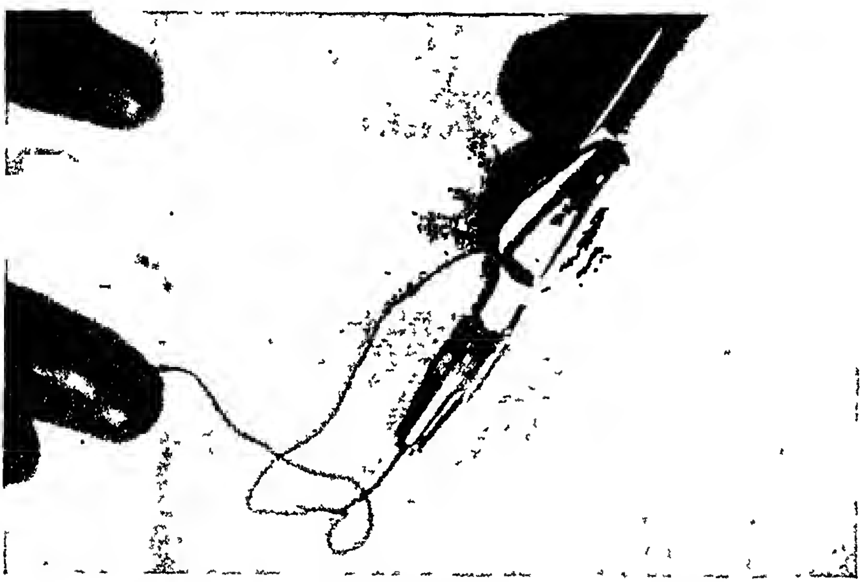

FIG. 3. HANDLE SHOWING ENCLOSED REEL OF SUTURE MATERIAL

The long ligature carrier can be used in correcting the deformity from facial paralysis by transplanted fascial strips, or may be bent for passing a tape in cleft palate work or radical mastoidectomy.

A stout full curved needle is used to pass a suture ligature under a bleeding vessel in the tonsillar fossa, or around the anterior ethmoid artery in external ethmoidectomy, or the sphenopalatine artery in injuries to that vessel.

A straight needle is used in transfixing the nasal septum in rhinoplasty. The hooks are used as tissue holders or retractors, and also for engaging the loop of thread to hold it as the needle is withdrawn.

The needles can be made with either round or cutting points and in various shapes and sizes.

Experience with the instrument will show certain things about its use which will require some care and practice. In pulling the thread from the needle it is

necessary to see the strand, so in fine work a loupe and a pointed hook are useful. If the needle is withdrawn slightly a loop is formed in the suture beyond the skin which facilitates grasping it with a hook or forceps. It is necessary to know on which side of the needle the short end of the suture is so that the needle is not unthreaded.

This is a small instrument, adapted to heavy or delicate work, simple to use, saves much time and makes possible the placing of sutures easily in locations hard to reach with conventional needles and needle holders.

A MULTIPLE KNIFE FOR DICING CARTILAGE

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A tedious job in the past has been the preparing of finely cut cubes of cartilage for filling in bony defects or for making a pinna after the method of Peer[1]. The instrument here described was devised to save time and to make fragments of controlled and more uniform size.

The knife illustrated consists of thin blades (double edged razor blades) embedded a millimeter apart and side by side in a plastic block, the blades projecting a centimeter from the block, and having their edges in the same plane. Another arrangement consists of a metal plate or frame with projecting lugs which fit into the holes and notches of single-edged razor blades which are retained in position by an opposing plate or frame and held by a clamp or nut. This permits renewing the blades, varying their number, and spacing them according to the distance apart of the requirements.

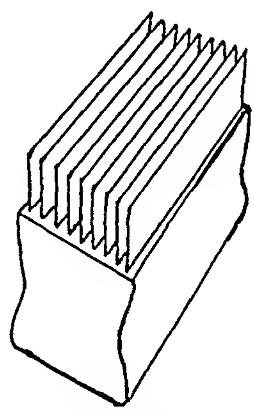

FIG. 1. DIAGRAM OF CARTILAGE KNIFE

The cartilage is cut by laying it on a solid surface and pressing the blades into it, almost through, then removing the knife. In large pieces more than one parallel cut can be made. The relative position of the knife and cartilage is then changed to make another cut at right angles to the first. The cartilage is then held with the edge perpendicular and a scalpel is used to shave across these cuts, making cubes. The remaining fragments can be further cut with the multiple knife so that none is wasted.

Presented before the American Society of Plastic and Reconstructive Surgery October 21, 1947.

[1] Peer, Lyndon A.: Total Reconstruction of the Ear. Read before the Sixteenth Annual Meeting of the American Society of Plastic and Reconstructive Surgery at San Francisco, October 23, 1947.

This instrument, arranged with two blades, is also useful for cutting strips of scalp to be grafted as eye brows and the margin of eyelids.

The author suggests that this instrument be called the Peer Knife in honor of Dr. Lyndon A. Peer of Newark, who has done so much pioneer work on the behavior and use of transplanted cartilage,[2,3,4,5] and who is the originator of the use of diced cartilage as a filling and supporting material in plastic surgery.[6,7]

[2] Peer, Lyndon [illegible] in the Brow, Eye Socket, Skull and Nose. [illegible]

[3] Peer, Lyndon [illegible] Transplantation in Human Tissues. Arch. [illegible]

[4] Peer, Lyndo[illegible] Arch. Otolaryngology, 42: 384–396, Nov.–D[illegible]

[illegible] the Growth of Young Human Car[illegible] July, 1946.

[illegible] of Otolaryngology, 38: 156–165, Aug., 1943.

[7] Peer, Lyndon A.: Cartilage Grafting. The Surgical Clinics of North America, April, 1944. New York Number.

A NOTE ON THE USE OF GRATED CADAVER CARTILAGE

J. PENN, J. JANKOWITZ AND A. BRUWER

South Africa

For the last two years we have been using grated necro-cartilage as a contour former. It is yet too early to pass a correct assessment as to its value in Plastic Surgery, for even in the use of massive and diced necrocartilage opinions are divided and the grated method is merely a modification of the others.

Grated cartilage has certain advantages over other forms in that it is very easy to apply and mould, withstands infection to an astonishing degree and gives a smooth contour with a good appearance of the overlying skin. It is particularly useful in filling up skull supra- and infra-orbital defects, saddle noses and retroposed chins.

There is no doubt however that absorption of the cartilage occurs. Whether this is total in its final analysis is impossible to say at the moment, but although

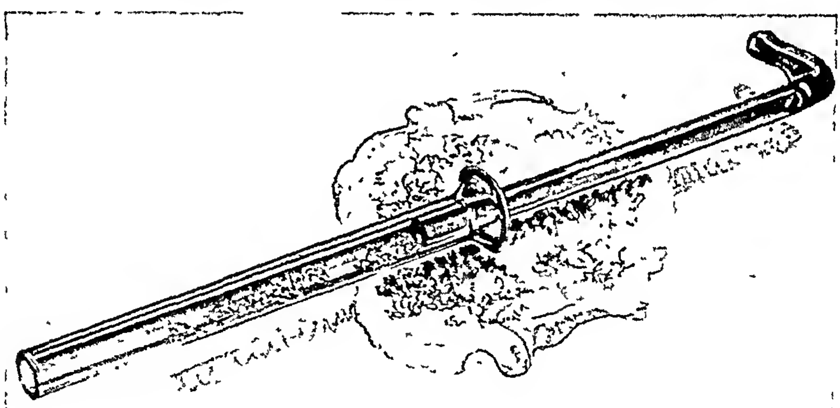

Fig. 1. Method of Filling Cylinder from Cylinder Bag

some cases require repeated applications to preserve height of contour others seem to preserve their shape for an indefinite period of time. Accurate microscopic observations on the fate of this form of implantation, which we have been unable to carry out, would undoubtedly shed light on this matter.

As the technique of application may be of interest we append here the method utilized in building up a saddle nose:

After removal of cartilage from the cadaver all perichondrium is removed and the cartilage is boiled and stored in merthiolate. It is then grated, utilizing the large mesh of an ordinary kitchen grater. The pulverized substance is then stored in little bags—we find 2″ x 2″ gauze a convenient size—and placed again in fresh merthiolate solution.

Immediately prior to use, the cartilage is packed into a glass cylinder, the lining

of which has been lubricated with glycerine. During this process we usually add sulphonylamide powder to the cartilage. As shown in sketch (fig. 1) a glass rod fits into the cylinder and acts as a piston. This simple apparatus was made for us by Dr. Robert Ivy and has been found to be very effective.

The bed for the receipt of the cartilage is prepared. This must be carefully performed as the future shape depends on the amount and direction of undermining carried out. The cartilage is now injected into position and packed down hard until tension causes blanching of the skin (fig. 2). The mass is moulded

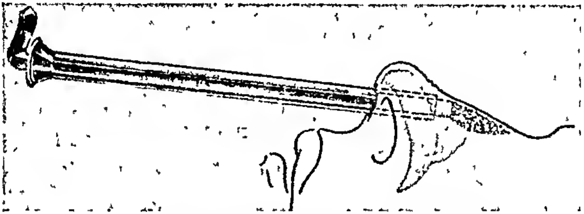

FIG. 2. CARTILAGE PACKED TO ELEVATE SADDLE NOSE

and sufficient of the excess squeezed out to ensure adequate blood supply to the overlying tissues.

The incision is sutured. No splintage is necessary.

When large amounts of cartilage are used, such as on the skull, we usually insert a silk worm gut drain, for in these cases serum collection is common.

Some of our cases have become infected but cartilage was not lost. It did, however, seem to increase the amount of fibrosis, and probably accelerated absorption of the cartilage itself.

EAR, NOSE AND THROAT (by George D. Wolf, M.D., published by J. B. Lippincott Company) is a newcomer to the library of competent works on otolaryngology already in existence. The subtitle of the book, reading simply, "Symptoms—Diagnosis—Treatment," keynotes the logical approach as well as the orderly arrangement of information which the reader will find throughout the volume.

A word of introduction concerning the author may perhaps be of interest. Occupying as he does the chair of Assistant Clinical Professor of Otolaryngology at New York Medical College, Dr. Wolf is in a position to speak with some authority on the subject of his specialty.

In his preface, Dr. Wolf succinctly sums up both the *raison d'être* of his book, as well as the special type of reader toward whom he has slanted it. Here, he tells us, is a work planned to take a middle-of-the-road course. Not too factually skeletal for the beginner, nor yet too crammed with medical minutiae of interest to the specialist alone, this is a manuscript addressed to the student, the teacher, and the practitioner who wishes a more extensive knowledge of otolaryngology.

Throughout, Dr. Wolf affirms his belief that greatest stress must be placed upon the patient's symptoms, rather than upon the disease itself, if correct diagnosis and cure are to ensue. Accordingly, in the many problems he discusses, his presentation of facts follows a consistent pattern of etiology, symptomatology, diagnosis, prognosis, and treatment.

Of particular concern to plastic surgeons is Part Four of the book, which is titled "Facial Malformations" and is somewhat of a departure in form from the remainder of the work. Here Dr. Wolf reviews the history of reconstructive surgery from its earliest beginning, as far back as two thousand years ago, up until today. He analyzes, in addition, the most commonly encountered facial disfigurements and effective operative procedures for their correction.

All in all, Dr. Wolf has produced a book of considerable merit. For some practitioners it may serve as a concise, "what-to-do-about-it" clinic manual, while for others it may be a satisfactorily inclusive reference work on diseases and deformities of the ear, nose, and throat. The writer's direct prose style, enriched with many explanatory illustrations, keeps author and reader traveling on the same track throughout.—Reviewed by Clarence R. Straatsma, M.D.

RHINOPLASTY AND RESTORATION OF FACIAL CONTOUR, published late in 1947 by F. A. Davis Company, comes from the pen of Jacques W. Maliniac, M.D., as a serious new monograph written by a specialist for the specialist. The subtitle of the book, "With Special Reference to Trauma," gives the reader an advance and correct inkling of the particular aspect of the plastic picture which the author will discuss.

Dr. Maliniac premises his book on the sound opinion that in the literature of reconstructive surgery too little attention has been focused upon the accidental and surgical traumas, legion in number, which directly or indirectly produce most of the external deformities encountered by the rhinoplastic surgeon. Concomitantly, he believes, the pathological anatomy involved in such traumas has been slighted, to an extent that some reparative surgeons fall far short in these cases of achieving the optimal cosmetic result possible.

Pursuing this line of thought, the author has made his book a knowledgeable discourse on nasal injuries. He scores the point that the unrecognized fracture can rightly be charged with causing much of the endonasal and external malformation which calls forth the skill of the reconstructive surgeon. Too, he excoriates the wait-and-see or, worse still, wait-until-adolescence-before-repair policy of some practitioners and even some plastic men in dealing with known nasal fractures.

Few, if any, surgeons would challenge the statement that the nose is target for more of "the slings and arrows of outrageous fortune" than any other part of the human body It is not surprising, therefore, that Dr Malniac has devoted the major part of his monograph to the nose He covers in satisfactory detail its anatomy, diagnosis of fractures, fundamental techniques in the treatment of nasal injuries, skin grafts and flaps, repair of septal malformation, depressed deformities, nasal asymmetries, and nasal loss Sections dealing with associated contour deformities and X ray diagnosis conclude the work

This is a book written not for the student or the general practitioner, but for the plastic surgeon of considerable experience In his own words, the author has chosen to be selective, rather than all inclusive, in the material he presents He has elected to avoid re statement and to stress techniques which have been screened in the light of his own knowledge

Dr Malniac's text is the more lucid for being enriched with over two hundred photographs and illustrations It is, moreover, dignified by a typeface—clearly readable, large, and unornate—that is in itself an invitation to the reader —Reviewed by Clarence R Straatsma, M.D

Reconstructive and Reparative Surgery, by Hans May, M D (published by F A Davis Company) is one of the most intelligent contributions to the written word on plastic surgery to come from the presses in some time Ambitious in scope and minute in clinical detail, this volume, in effect provides the reader with an amphitheater seat in the operating room where he may witness approved techniques for performing almost every type of operation known to reconstructive surgery, with all its many specialties within the specialty

So distinguished a surgeon as Dr May requires little or no introduction to his colleagues in the plastic field However, the surgeon in general practice may find it interesting to learn that this book is the fruit of many years of Dr May's own skill and experience, not only in the United States but in Germany as well, where he formerly trained with Dr Erich Lexer It is, furthermore, his evaluation of the most dependable plastic procedures of several other surgeons, both American and foreign, as attested to by his copious bibliography

Two well known medical men, Dr David M Davis and Dr Coverley Smith, have added their authority to the work as contributing writers Dr Robert H Ivy and Colonel James Barrett Brown, together with other illustrious names too numerous to note, have previewed before publication sections of the text dealing with their various specialties Rounding out the volume there is a wealth of splendid illustrations, including drawings by Mr and Mrs William B McNett (many sketched on the scene at the operating table) and photographs by Mr E Richard Deate

Dr May has built his book around a broad framework of five major divisions, each presenting in meticulous detail some aspect of the plastic picture with its multitudinous problems Division One takes up general technique, such as grafting of tissue, transplantation of flaps, treatment of burns, wounds, and scars Subsequently, Divisions Two to Four discuss, respectively, reparative methods as applied to the head and neck, the trunk, and the extremities Division Five contains numerous photographic case histories illustrating reconstructive procedures previously described

To give the prospective reader an accurate *critique* of this book, I cannot emphasize too strongly the point which the author himself stresses in his preface It is a manuscript planned primarily to acquaint the general surgeon more fully with the reconstructive specialties, and secondarily to demonstrate the applicability and the carry-over of sound reparative techniques from one specialty to another Hence, highly specialized plastic surgeons who practise within a narrow compass may find cause to challenge some of Dr May's material where it impinges upon their particular sphere of knowledge

Perhaps I can best amplify this thought by citing Division Five on "Illustrative Cases" In pages 756 through 769 Dr May has shown before and after photographic examples of several types of nasal plastic operations In the main I consider these to be incomplete

repairs from the standpoint of the maximal cosmetic result which one might hope to achieve. Further, pursuing the same subject, I might chalk up some points of disagreement, gleaned from my own experience, with the reconstructive methods advanced by Dr. May in Division Two, Chapter Nine, for the nose and intranasal regions. Yet, simultaneously, I must agree with the author that these same techniques are essentially sound for the general surgeon or for the plastic man who has not yet crystallized his own preferred procedures.

Viewed as a whole, Dr. May's book is a most serious and competent study, dateline 1947, of the highly diversified field of plastic surgery. Both general and plastic surgeon will find in this work much to recommend it as an authoritative reference on today's most effective reconstructive and reparative techniques.—Reviewed by Clarence R. Straatsma, M.D.

March 1948

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

Meyer, F L, Hirshfeld, J W, and Abbott, W. E Metabolic Alterations Following Thermal Burns VII Effect of Force-Feeding, Methionine, and Testosterone Propionate on Nitrogen Balance in Experimental Burns *J Clin Investigation 26* 796, July, 1947

In the investigation of metabolic alterations following thermal burns presented by Meyer and his associates, 8 female dogs were first studied as to their normal nitrogen balance These animals were subsequently divided into pairs, and each pair was subjected to one of four methods of preventing post burn negative nitrogen balance The four experiments included (1) forced feeding with triple control protein intake and twice the control caloric intake, (2) forced feeding with triple control protein intake but similar caloric intake, (3) control diet and daily injections of testosterone propionate, and (4) control diet and daily methionine dosage Forced feeding produced improved nitrogen balance but was poorly tolerated Methionine did not appear to affect the nitrogen balance, while testosterone propionate appeared to reduce the nitrogen loss significantly

The authors suggest that in the clinical

and include 200 grams of protein

Flynn, J Edward, Lt Col Burned and Traumatic Hands *Arch Surg 54* 249, Mar 1947

A complete plan for the management of all

types of thermal and traumatic injuries of the hands is presented by Flynn. The latter half of the article is devoted to other forms of hand trauma. The presentation reveals wide experience and careful attention to details.

Editorial Comment: Much of the painstaking and perfunctory collaborated work could be eliminated to afford a more concise and practical plan both for military and general civilian usage. The essential features for caution and emphasis are well selected by Flynn. His suggestions concerning the management of third degree burns before grafting, and the length of time before grafting might well be revised, and permit a more rapid covering and early function of the denuded part.

Stewart, O. W., and Botterell, E. H.: Cranio-Facial-Orbital Wounds Involving Paranasal Sinuses: Primary Definitive Surgical Treatment. From the Neurosurgical Service of the Basingstoke Neurological and Plastic Surgery Hospital, R.C.A.M.C. *Brit. J. Surg., War Surgery Supplement No. 1.* Wounds of the Head.

The purpose of this article by Stewart and Botterell is to emphasize the desirability of primary definitive surgical treatment in cranio-facial-orbital wounds, due to high-velocity missiles-wounds which involve the paranasal sinuses. The authors quote Schorstein as advocating, as the procedure of choice, the primary repair of the dura by fascial grafting, laying open the sinuses and removing the mucous membrane. It is the belief of the authors that surgical treatment should be carried out completely and finally at the first operation, as early as possible after wounding.

Their treatment consists of:

(1) Radical débridement of cranial and cerebral wounds.

(2) Débridement of damaged paranasal sinuses, with the establishment of adequate drainage through the nose.

(3) Sealing of the subdural and subarachnoid spaces.

(4) Closure of the scalp without tension and without drainage, by use of large scalp flaps with free skin grafts applied to a secondary defect where necessary.

The application of a split-thickness skin graft to close the primary scalp defect following débridement of a cranio-facial-orbital wound is not advocated. To achieve closure when there has been extensive tissue loss, the procedure of choice is the rotation scalp flap of the single or double "S" type. Triradiate incisions are undesirable, for the maximum tension on the suture lines is situated over the center of the cranial defect. In dealing with scalp defects over the forehead, Stewart and Botterell continue, irregularities of the hair-line must be accepted where a large single flap is used. The secondary defect may be packed and dealt with later or a split-thickness skin graft applied at once.

Sepsis and Mortality: Complete primary closure of the scalp was carried out in 20 of a group of 25 patients receiving primary surgical treatment by the authors; three died. In one case, the patient, already grossly infected before operation, developed postoperative sepsis and died. One of the patients in whom the wound was packed open because of gross infection, developed meningitis and died. A third patient, a prisoner-of-war, with advanced pulmonary tuberculosis, died as anesthesia was being induced.

Rhinorrhea and Pneumocranium: Neither persisting rhinorrhea nor pneumocranium was observed by the authors in the weeks following operation.

Late Results: Fourteen of the patients were Canadians, as were all the patients in the cases "followed up." One of these died from infection. In the 13 survivors who have been followed up for 18 to 22 months, there has been no deep intracranial infection, no rhinorrhea and no pneumocranium.

Conclusions: (1) These wounds should be operated upon once, and completely, as soon after injury as circumstances permit. (2) In the majority of patients treated with full chemotherapy, complications resulting from incomplete operation outweigh in significance the dangers of delaying surgical treatment for 3 days or perhaps longer.

Kazanjian, V. H., and Webster, R. C.: Treatment of Extensive Losses of the

Scalp *Plast & Reconstruct Surg 1* 360, Nov 1946

In the treatment of extensive losses of the scalp Kazanjian and Webster state that they have had greater success with thick split grafts applied as soon as possible than any other type of graft provided the periosteum is present However, if the periosteum has been lost, the treatment differs considerably When this condition exists, they establish contact with the diploic vessels lying between the two tables of the skull, by chiselling away the outer cortex until multiple bleeding points appear In one week or slightly more the granulations springing from these bleeding points coalesce and produce a fine carpet of granulations ideally receptive to grafting

The authors present 7 case histories with excellent illustrations They also list the complications caused by late contracture and complications caused by breakdown of scar epithelium

Editorial Comment This is a complete and well-organized article on repair of scalp deformities, covering the anatomy of the scalp, with particular emphasis on the blood supply, which is most important in flap repair

After brief paragraphs on the history and emphasis on the general care of patients with this condition, the etiology is well handled

Of particular interest is the treatment of the subject by Kazanjian and Webster when the periosteum is absent and when it is present

EYE

Sherman, Arthur E Reconstruction of the Eyelid *Tr Am Acad Ophth* May–June, 1947, p 514

Based on his experiences with several hundred battle casualties requiring ophthalmic plastic surgery at one of the Army centers for plastic and ophthalmic surgery during 1944 to 1946, Sherman lists the procedures that, to his mind, gave the most satisfactory results for various degrees of eyelid reconstruction

For replacing eyelid skin alone careful adherence to Wheeler's technic of free full thickness skin graft with intermarginal lid adhesions gave practically perfect results Upper eyelid skin is to be preferred for the graft, with postauricular and supraclavicular skin as second and third choice

When there is a small vertical full thickness loss of an eyelid, Wheeler's "halving" method of repair is the procedure of choice Larger colobomatous defects involving a loss of up to one third the length of the eyelid can be very satisfactorily closed by this method together with an extended lateral canthotomy to allow the tissues to slide from the temporal side

Hughes' method of total eyelid reconstruction was found to be very useful and gave excellent results when little more than the tarsal portion of the eyelid was missing For more extensive losses of the lower eyelid this method was also used after some elevation of the skin and subcutaneous tissue below by means of sliding flaps

Free grafts of 3 mm wide strips taken from the midportion of the nasal half of the eyebrow gave fairly satisfactory eyelash grafts These grafts, as well as additional grafts of skin for the eyelid, or of fascia lata or bone to fill in defects of the orbital margin, should be accomplished before the new eye fissure is cut

At times additional mucous membrane is needed to enlarge a cul de sac, especially in cases of anophthalmos, for this a free graft of buccal mucous membrane is preferred

Rarely need one use a pedicle flap from the forehead or cheek in eyelid reconstruction

Ten cases illustrate the article

Sherman, Arthur E Reconstruction of Orbital Floor Defects *Surg Gynec Obst 84* 799, Apr 1947

The importance of early diagnosis and reduction of depressed fracture of the orbital floor is stressed by Sherman

Reconstruction of the depressed floor is indicated only in those cases where there is obvious depression of the orbital contents, with retraction of the tissues below the brow Sherman favors the use of inorganic material such as a wedge shaped piece of acrylic resin to elevate the orbital contents This is placed under the periorbita of the depressed floor with careful closure of the periorbital at the lower orbital margin This material is preferred to cartilage or bone because it

eliminates the additional procedure of taking a cartilage or bone graft. Moreover, the acrylic resin is well tolerated and apparently remains unchanged.

Small defects of the lower orbital margin are satisfactorily filled with fascia lata. Larger losses are best replaced by a graft of cancellous bone from the ilium. This is preferred to cartilage or inorganic materials because the bone graft quickly becomes attached to the adjacent bone and gives a firm lasting contour.

The article is accompanied by 7 illustrative cases.

Spaeth, Edmund B.: Reconstruction of Upper Lid. *Surg. Gynec. Obst. 84:* 804, Apr. 1947.

Spaeth states that the technic used in reconstruction of the eyelid may vary, depending on whether a functioning eyeball is present or not.

When there is a loss of the posterior surface of the eyelid, a new cul-de-sac must be reconstructed. When the eyeball is present a mucous membrane graft should be used. If the eye has been lost, a thin razor graft of skin may be used instead of mucous membrane. If there is also a deficiency of the external surface of the lid, Spaeth advocates the use of a pedicle flap from the forehead or cheek, on the under surface of which there is a previously placed thin razor graft of skin to form the posterior surface of the reconstructed eyelid.

When a normally functioning eye is present, a procedure which joins the opposing normal lid to the remains of the lid to be reconstructed is preferred, such as that of Landolt or Hughes. These procedures utilize a portion of the tarsus and conjunctiva from the normal eyelid in the reconstructed lid.

In cases in which there has not been much loss of soft tissue, it may be necessary only to excise the deforming scars and resuture the tissues in the proper position.

Eight illustrative cases accompany the article.

NOSE AND EAR

Coates, George Morrison: Two Problems: Care of the Deafened and Rhinoplastic Surgery. *Tr. Am. Acad. Ophth.* Sept.-Oct. 1946, p. 11.

Coates pleads for the inclusion of reparative surgery in the field of otorhinolaryngology. It is his view that the rhinologist, by virtue of his training and familiarity with nasal anatomy, physiology and instrumentation, is preeminently fitted to perform rhinoplasties, and is therefore not stepping beyond the boundaries of his own specialty into that of plastic surgery. Furthermore, every rhinologist at one time or another in the course of his practice has had to perform some minor or major correction on the nose and ear, and the author points to the submucous resection of the septum as a typical plastic procedure. Among other such procedures carried out for many years by competent otolaryngologists, he mentions reconstruction of the lacrimal duct and the external auditory canal, closure of retroauricular fistulae, and correction of cleft lip, cleft palate, and the defects which sometimes follow radical sinus surgery.

Rhinoplasties often simultaneously fulfil a dual purpose, that is, functional as well as esthetic, for they usually involve not only the correction of unsightly deformities but also improvement in impaired physiology. The restoration of normal breathing, for example, is in many cases not entirely complete unless accompanied by some rhinoplastic procedure; on the other hand, a submucous resection is frequently required to supplement a rhinoplasty.

There is a growing interest in rhinoplasty among rhinologists, the author concludes; and those who desire to practice this special type of surgery, "should have opportunities for proper preparation and not be forced or allowed to acquire this technic on the trial and error basis." In view of this, he advocates that this type of plastic surgery be accorded a definite place in courses of instruction designed for both residents and students in this field. He suggests also that similar training might well be extended to all candidates preparing for Board Examinations.

Editorial Comment: While it is true that reparative surgery is not entirely outside the scope of rhinological and otolaryngological practice, there are certain qualifications, in addition to general surgical and rhinological training, which are indispensable for

successful reconstructive surgery in his field One may consider an aptitude for surgical sculpturing an essential prerequisite, and even the most competent of rhinologists or general surgeons do not always possess the ability or the inclination to carry on this highly specialized type of work This may account for the fact that out of the numerous rhinologists and general surgeons who were most eager to follow reconstructive surgery after the First World War, relatively few of them attained the necessary skill or continued very long to try That is not to say, of course, that rhinologists with a good surgical background *plus artistic imagination*, if given the opportunity for specialized training, could not enter and become successful in this field There are many such, no doubt, but the reviewer's experience during the last 30 years, in this country as well as abroad, has demonstrated that, with but few exceptions, rhinologists who did pursue and did become proficient in reconstructive surgery were forced eventually to abandon rhinolaryngological practice This is probably due to the fact that reparative surgery is a time-consuming specialty, the proper management of which calls for deliberate and unhurried practice, allowing no time for interference by otorhinolaryngological routine The conscientious practitioner must therefore choose between the two, for in order to carry out even "minor" facial plastic operations requires careful planning and execution, and demands of the surgeon that he be not only well grounded in surgery, but that he be especially endowed with the faculty of artistic visualization and understanding Particularly is this true in plastic procedures involving the nose and ear, which structures by reason of their prominence and conspicuousness are most likely to incite strong psychological reactions to even slight deformities Moreover, the threat of malpractice in plastic surgery is much too real to encourage anyone to practice it unless and until he is adequately qualified and thoroughly experienced

Pickrell, Kenneth L.: Nasal Deformities and Their Repair. *Surgery, 20* 845, Dec 1946

In this paper, Pickrell discusses the psychologic aspects of nasal deformities and points out the need for tolerant and sympathetic consideration of the very real unhappiness and mental anguish which such deformities produce In view of the notable achievements in reconstructive surgery, he says, "patient resignation" to nasal disfigurement so often advocated by physicians and friends alike, is neither good advice nor is it kind, for in many instances it requires only a comparatively simple operation to bring about marked physical improvement and complete psychological relief

The author emphasizes the importance of careful psychiatric diagnosis, however, before prescribing surgery The plastic surgeon must distinguish between those patients who present a complex directly attributable to the deformity and hence promise a good postoperative reaction, and those with a chronic psychiatric condition in whom no degree of repair will suffice but will result only in other symptoms giving rise to further emotional disturbances The latter type, of course, is to be avoided, and the surgeon when in doubt should not hesitate to seek out the aid of a psychiatrist to help him differentiate the two types

The anatomy and structure of the nose and various types of nasal deformities are described, followed by preoperative analysis of each type with a suggested plan of reconstruction Methods of procedure employed by a number of surgeons are outlined with more or less technical detail, and are illustrated by diagrammatic sketches depicting the successive stages of operation, accompanied by before- and after photographs of individual patients

Shearer, William L Atresia or Stenosis of the Nares *Nebraska State Med J 32* 116, Mar 1947

It has been Shearer's experience that atresia of the nares is commonly found in connection with other congenital anomalies such as cleft lip and palate, postnasal dermoid, spina bifida, club foot, *et cetera*

Maintaining a surgical opening presents the greatest difficulty in the management of atresia of the nares

A flange is vulcanized on a rubber catheter, which is passed from the pharynx through the nose after the opening has been created surgically The catheter is fastened

to the columella. Two catheters are used for bilateral atresia. The catheters are kept open by saline irrigations or a probe, and are kept in place from 4 to 6 weeks. The child can breathe through the catheter during this time.

The author has had 5 cases, either unilateral or bilateral, associated with cleft lip and palate, which have been handled successfully in this manner.

Editorial Comment: Shearer's experience that all of his cases were associated with cleft lip and palate is unusual. Furthermore, many operators find that dilation for 6 weeks is not the final answer to the correction of the stenosis because of subsequent scar contracture.

Kazanjian, V. H., and Holmes, E. M.: New Rongeur for Removing a Nasal Hump. *Arch. Otolaryng. 45:* 361, Mar. 1947.

Kazanjian and Holmes describe a pair of "straight-cutting bone rongeurs" which they devised for the removal of the osteocartilaginous hump. In their experience the instruments have proved to be a satisfactory substitute for the standard saw-chisel-rasp combination now in common use for this purpose. Their chief objective was a "one-motion" instrument that would accomplish removal of bone and cartilage at the same time.

The first rongeur, adaptable in the majority of cases, has the blade on its lower surface and was designed primarily for use in instances where the skin is freely movable. Its special feature is that it permits a straight cut through the bone without changing its path and without possible injury to the tissues. The second rongeur has its blade offset upward and is especially effective in cases which present a vestibule resistant to elevation and thus inhibit instrumentation at the desired level. The advantage of the cutting blade offset upward about a ¼ inch circumvents such a difficulty. The authors acknowledge a slight drawback in the second rongeur, not too serious, however, for simple remedial management, which they explain clearly.

Technical manipulation during each successive step of operation is described in detail, with diagrammatic illustrations.

Franklyn, Robert A.: Refinements in Plastic Surgery of the Nose and Ear. *Eye, Ear, Nose and Throat Monthly, 26:* 419, Aug. 1947.

The surgical treatment of protruding ears by incision of the auricular cartilage through a posterior incision is described by Franklyn. The cartilage is incised in such a manner as to permit the construction of a new antihelix when the rim of the ear is held back in a normal position. The incised cartilage is held in its new position by a size No. 0 white silk mattress suture passed through the medial perichondrium and cartilage at the upper one-third of the incision. Excess skin is removed at the site of the original skin incision. A removable stainless steel or tantalum wire may be used instead of the buried silk suture, fastened externally with a lead shot and removed in 3 weeks.

Editorial Comment: The "lop ear" correction advanced in this article as a "new refinement" is essentially the same as that advanced by Luckett in 1910.

HARELIP AND CLEFT PALATE

Dorrance, G. M., and Bransfield, J. W.: Studies in the Anatomy and Repair of Cleft Palate. *Surg. Gynec. Obst. 84:* 878, Apr. 15, 1947.

Dorrance and Bransfield dissected the palate and structures associated with it and show that normal closure is caused by contraction of the outer fibers of the superior constrictor muscle, which runs to the hamular process on each side, pulling the posterior wall of the pharynx forward. This permits the inner portion of the superior constrictor muscle to act as a sphincter and thus to produce closure.

By retrodisplacing the palate so that the attachment of the palatine aponeurosis is displaced backward, the circular muscle portion of the superior constrictor muscle is capable of obtaining velopharyngeal closure, and normal speech ensues.

The authors think it advisable to wait until the child is in his fourth or fifth year before operating, as there are then less anatomical failures, and less loss of flaps; speech is better than that obtained with early operations.

With their push-back operation good speech has been obtained in patients re-

paired by the von Langenbeck method Dorrance and Bransfield use a modified push-back method in which they raise the flap and cover the raw surface with a skin graft so as to produce a freely movable palate When a hole remains in the anterior part of the mouth, a plate will cover it with little difficulty

When teeth are present in cleft palate operations, a splint is used as a means of protecting the suture line

There are 15 sketches showing the various processes

Schultz, Louis W. Bilateral Cleft Lips *Plast & Reconstruct Surg 1* 338, Nov 1946

Schultz gives a detailed report on how the intermaxillary segment can be immobilized in two ways in repair of bilateral cleft lips, namely (1) by making a submucous diagonal incision through the cartilaginous septum and then sliding one segment of the vomer over the other (though this technic may produce a nasal obstruction later in life), and (2) by a submucous resection of a small V-shaped section of the septum

The baby should be given rest of at least one month Then the lip should be constructed, preferably by the technic which the author has devised By this procedure he claims he can produce a much better lip in 98 per cent of these cases A good lip results, having full thickness including the cupid's bow, the deep vestibule and almost normal contour

BREAST

Pickrell, K. L , Metzger, J., and Holloway, J. B.: Plastic Surgery of the Breast *Surg Clin North America 26* 1095, Oct 1946

Present-day methods employed in reconstructing hypertrophied breasts are presented by Pickrell, Metzger and Holloway They emphasize that correction of such afflictions is not only justifiable but obligatory in cases where the hypertrophy may lead to disfigurement and disability, as it often does "Markedly hypertrophied breasts," say the authors, "are in many instances comparable to benign tumors," and as such are deserving of more attention and treatment than have been accorded them in the past among the medical profession in general And since psychological as well as physical factors are involved, corrective surgery is here indicated no less than in gynecomastia in the male or other well recognized deformities

Among the several methods employed by various surgeons from time to time, the authors consider the procedures of choice to be mainly those which include transposition of the retained nipple and areola with wedge shaped resections of breast tissue, followed by mastopexy Partial mastectomy with free transplantation of the detached nipple is indicated in massive hypertrophies Whichever plan is followed, however, it should be based on the principles laid down by Malniac, which emphasize preservation of the blood supply and such mammary function as may be present, prevention of recurrence of pendulousness, minimal scarring and maximal symmetry

The two stage methods of both Malniac and Lamont are described in more or less detail Malniac's first stage consists of an outline of a horizontal flap, minimal reduction of the gland, and transposition of the nipple and areola subcutaneously The second stage, which follows in about 4 to 6 weeks, consists of removing all excessive fat and glandular tissue, and of shaping the skin flaps Both breasts are subjected to surgery simultaneously in both the first and second stage, so that the total time required for complete reconstruction is no longer than that utilized in the one stage, one breast at a time procedure

Lamont also allows for preservation of blood supply, but differs somewhat in his technic The Lamont mastopexy includes removal of sections of the gland from the upper lateral quadrants

Subtotal mastectomy with free transplantation of the nipple or construction of an artificial nipple is, in the authors' opinion, to be avoided, and should be regarded solely as "a procedure of necessity" in only such cases of massive hypertrophy where other procedures might prove inadequate A complete pre- and post-operative report of one such case is presented—that of a 22 year old Negro multigravida with hypertrophic breasts weighing a total of 54 pounds

Editorial Comment The two-stage pro-

cedure described by the authors, as used by Maliniac in cases of massive hypertrophied breasts, dates back to 1934. Since then, a number of modifications have been evolved to reduce the size of the gland as well as to shape external flaps. In affixation of the gland it is important (and this should invariably be carried out) that non-absorbable material be used, preferably dermal loops.

Excision or removal of glandular structure from areas where the main vascular pedicles originate (Lamont's procedure) is contraindicated because of endangering survival of the nipple.

Webster, Jerome P.: Mastectomy for Gynecomastia through a Semicircular Intra-areolar Incision. *Ann.Surg.124:* 557, Sept. 1946.

The various types of gynecomastia and indications for corrective therapy, are discussed by Webster, with special emphasis on attendant psychic trauma. He concurs in the belief that surgical correction offers the most satisfactory results, and describes his method of *intra-areolar* mastectomy as opposed to the commonly advocated *extra-areolar* procedures. It is his conviction that a telltale postoperative scar in a sensitive individual is to be regarded as a deformity in itself. For the best psychological results, therefore, the operative procedure should be such as to reduce the scar remnant to an absolute minimum. An operation confined to the areolar region achieves this objective, because incisions in the areola rarely leave more than a most inconspicuous scar.

This article is based on the author's experience with 17 cases, in 15 of which there was bilateral involvement, the remaining 2 being unilateral—a total of 32 mastectomies. All 17 patients exhibited preoperative complexes. Webster reports excellent results in every instance except three. Failure in one of these exceptions is attributed to a residual nipple deformity due to necrosis, and the other two patients were dissatisfied because of insufficient reduction of the hypertrophy. However, he feels that the final appearance of all these patients will bear comparison with results obtained by other procedures. Moreover, of the utmost importance, in his opinion, is the fact that absence of "noticeable scars" affords the patient complete psychological relief.

The author's method begins with a semicircular incision just within the margin of the pigmented area. Throughout the procedure, subcutaneous manipulation is stressed. The breast tissue is freed, then halved and quartered for easier removal in sections, the surgeon making sure to leave enough fat over the pectoral fascia to allow for a subsequent smooth and even obliteration of the cavity. In removing hypertrophic tissue, it is advisable to err on the side of over-removal, because "what may appear sufficient on the operating table when the patient is supine subsequently may appear insufficient when he is erect." Extreme care must be exercised in closing the wound to guard against distortion of the areola. Closure without drainage is preferable.

The operation is performed under general anesthesia, and in bilateral involvement two operative teams work simultaneously to reduce the length of the operative time. This calls for careful matching of technic to ensure bilateral symmetry. Webster concludes with the caution that "careful technic and meticulous hemostasis," together with "considerable skill, judgment and patience," are required of the surgeon for optimum success.

Editorial Comment: It is agreed that in limited hypertrophies, removal of excess glandular tissue is satisfactorily accomplished through intra-areolar incision. On the other hand, in cases of pseudogynecomastia which present large masses of adipose tissue, subcutaneous removal of such fatty masses without simultaneous adjustment of the skin covering will result in breasts of faulty shape. Placement of the incision in the submammary fold would appear to be preferable, since this permits simultaneous removal of both excess fat and redundant skin, thus resulting in a more shapely gland, with inconspicuous scarring at the same time.

Weber, F. Parks: Gynecomastia, Especially in Regard to the Effects of Endocrine Tumors. *Med. Press & Circ. 111:* 155, Mar. 8, 1944.

In summarizing the somatic effects of

endocrine tumors in respect to gynecomastia, Weber says that it is not enough to accept hormonic influence as contributory to the formation of endocrine tumore. We must consider also the "zygotic make-up of the individual, including hereditary tendencies, temporarily modified by age, and other circumstances which help to constituto the 'soil' on which the hormones work." Furthermore, ho theorizes, the "zygotic" constituent may play an important rôle in unilateral predisposition, so that any one region or organ may manifest a greater reaction toward hormonic effects than another, or may he the only ono to react at all. He makes ssveral references to the literature, describing his own experience and that of other investigators in support of this theory, particularly in connection with the gynecomastia encountered among adolescents.

The following types of gynecomastia are differentiated:

(1) *Gynecomastia ond Endocrine Tumors of the Adrenol Cortex:* Mention is mads of a typical case in which a primary malignant hypernephroma of tho left suprarenal cortex exerted sufficient hormonic lnfluence as to cause acute mammary feminism. This is in sharp contrast to the usual effects of cortical hypernephromata, which in the female usually induco features of virilism, and in the male, increase rather than diminish virilistic features.

(2) *Gynecomastio* ond *Endocrine Tumors of the Pituitary Gland:* This type has been observed in acromegaly, and sometimes occurs in association with non-endocrine tumors of the pineal body. Such tumors, acting through pressure on the hypothalamus, stimulate hormone productlon and give rise to marked sexual and somatic overgrowth in boys. The reader is again referred to the literature for greater detail.

(3) *Gynecomastia* ond *Endocrine Tumors of the Testis:* This condition has heen noted in certain cases of teratoma testis, thought to he due to the chorion-carcinomatous elements present. Gynecomastia may occasionally follow prostatectomy, castration in early life, and testicular injury or atrophy from various causes.

(4) *Gynecomostio* ond *Endocrine Tumors of the Thymus:* Still further evidence of the tumor-gynecomastia relationship is offered in Weber's description of the case of a 16-year old boy with bilateral gynecomastia and a rapidly growing primary thymic tumor. Roentgen-ray therapy was instituted, which resulted in disappearance of the tumor, and along with it a noticeable diminution of the gynecomastia.

Richardson, J. S.: Gynecomastia with Bilateral Undescended Testes in Man Aged 21. *Proc. Royol Med. Soc., 39:* 513, July 1946.

The case of a 21-year old male who had bilateral gynecomastia with cryptorchidism is described hy Richardson. The patient gave a history of swelling of the hreasts, first noted when he was about 16 years old. The swelling was accompanied hy sensations of tenderness and pain.

The author carried out a numher of hormone-determination tests and found that, although there was no dsficiency in tho androgen supply, there appeared to he an over-productlon of the follicular stimulant, thus giving rise to an hormonal imhalance. He ascribes the gynecomastia to the presence of this excessive follIculin-stimulatlng hormone

MISCELLANEA

Brown, *Adolph M.*: Sculptured Synthetic Prostheses as Implants in Plastic Surgery. *Arch. Otolaryng. 45:* 339, Mar. 1947.

Brown comments on the limited availability of satisfactory suhstances suitable for implants in restorative surgery, and extols tho merits of the newer synthetic resins which, in his opinion, "promise immense advantages in this field." Acrylic implants meet every one of the requirements essential to good prostheses, he believes. They are superior to the more commonly used ivory, bone and cartilage in that thsy are not absorbable, do not curl or shrink, are more resistant to dimensional change, and because of their inertness are less apt to irritato the surrounding tissue, as may the viable autogenous and homogenous substances. Under ideal circumstances, an ideal procedure would bo to mold and shape the implant away from the operating room, thus effecting a great saving of operative

time. Brown suggests that the synthetic materials offer such a possibility.

Summing up the desirable properties possessed by acrylic prostheses, he adds also "simplicity and inexpensiveness of technic," and notes that plastic surgery is due to profit considerably by a wider use of chemical plastics because of the vast research in this field now going on all over the world. "Every gain in the field of synthetic plastics," he concludes, "is a possible gain in the field of plastic surgery."

The technic for making synthetic implants is described in detail. Surgical procedure is essentially the same as with any other transplant, except that a slightly larger incision may be required to accommodate ready-made contours not attainable in other substances.

Editorial Comment: Present-day consensus of opinion among well-qualified plastic surgeons is that autogenous material, such as cartilage and bone, is first choice in the selection of supporting grafts. Isogenous grafts and preserved cartilage make good substitutes in some cases. Alloplastic transplants, however, are as a rule contraindicated for use as supporting structures.

Sachs, Wilbert, MacKee, George, Schwartz, Oscar, and Pierson, Herbert: Junction Nevus—Nevocarcinoma (the So-Called Melanoma Group). *J. A. M. A. 135:* 216, Sept. 27, 1947.

The diagnosis and management of junction nevus and nevocarcinoma are discussed by Sachs *et alii*. They state that objection to the term melanoma is based upon its ambiguity. Junction nevus is defined as a cellular nevus in which nests of nevus cells can be seen with ease in the basal-cell zone. It is called junction nevus because it arises at the junction of the epidermis and cutis. It is synonymous with melanoma, benign melanoma, epidermic-dermic nevus and schwannoma. Nevocarcinoma is the same as melanoma, malignant melanoma, melanocarcinoma, melanoblastoma and melanosarcoma; nevocarcinoma without pigment is identical with amelanotic melanoma.

Junction nevus usually is described, say the authors, as a pea-sized, flat or slightly raised, smooth, non-hairy lesion of a deep brown to black color. However, the lesion may vary in size from 1 mm. to several centimeters, extend considerably above the surface, be verrucous, have hair and be nonpigmented.

They consider biopsy of prime importance in making a conclusive diagnosis. They have never known cancer to develop as a result of biopsy nor, to their knowledge, has biopsy increased the degree of malignancy in existing nevocarcinoma. Microscopic examination should be made in all cases of suspected junction nevus and nevocarcinoma. Small lesions should be removed entirely and then examined; from larger lesions a small piece, about 0.5 cm. in diameter, is sufficient for examination. Reports on such biopsies should be made within a few days. The necessary treatment should be instituted promptly.

Malignant change in a junction nevus results in a nevocarcinoma. This alteration may be insidious or rapid. Although signs of this change may be detected clinically, alteration in the character of the cells or the extension of the process may be so gradual as to give no visible evidence of its occurrence. Nevocarcinoma is divided by Sachs and his associates into early or late stages based on the degree of malignancy found, rather than on a time factor. The differential microscopic features of junction nevus and early nevocarcinoma are discussed.

It is the opinion of the authors that malignant changes may occur with or without trauma. Injury may be slow and gradual, as in shaving, combing, irritation from clothing or exposure to pressure, or may be specific and rapid, as by a blow or bruise. Improper treatment of the junction nevus is a form of trauma and may be followed by early or late nevocarcinoma.

As the junction nevus is the precursor of nevocarcinoma, it should be removed, but the nevus is all that needs to be excised. When malignant change develops, there are different gradations, and the therapy and prognosis vary accordingly. The malignant lesion should be removed by wide excision and followed at times by radiation therapy. The authors do not discuss the question of the regional lymph nodes.

Meeker, Louise H., and Aebi, Rudolf. Cyclopean Eye and Lateral Proboscis with Normal One-Half Face. *Arch Ophth 38* 159, Aug 1947

This is a follow up report of a case described by Meeker and Aebi in 1942 They failed to find other reports of the association of a cyclopean eye, lateral proboscis, cleft palate and cleft lip The "lateral proboscis" was a rudimentary, tubular half of the nose which was attached to the superior nasal part of the orbit It was 40 mm long, 10 mm in diameter, and had an opening, 2 mm in diameter, from which mucus could be expressed This rudimentary half of the nose was amputated The microscopic sections showed the presence of mucosa, cartilage and skin The child had a normal development of the right side of the face A review of other somewhat similar cases leads the authors to conclude that the defects are the result of incomplete separation of monozygotic twins, they lay great stress on the hereditary factor

Editorial Comment The management of the tubular nasal remnant offers a challenge to the plastic surgeon It would seem more feasible to utilize this structure for the reconstruction of the nose than to amputate it

CORRECTION

In connection with his article entitled "Early Maxillo-facial Surgery, etc ", which appeared in the March, 1948 issue, page 209, Dr Milton S Travin wishes to state that the chiefs of the team who supervised and directed the Maxillo-facial Surgery in the report were Lt Col Milton Reder, M C and Major J Dorsey, M D

THE PREPARATION OF GRANULATING WOUNDS FOR GRAFTING (A METHOD)*

JAMES T MILLS, M D , JOHN B PATTERSON, M D AND R EUGENE HOUSE, M D

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A large majority of the burns seen on our service are ones which have survived the acute phase and have been referred because of full thickness skin loss of varying extent When first seen most of them are grossly infected and covered with exuberant granulations The method which we employ to transform these large infected wounds into relatively clean ones is anything but new it having been widely used by various groups and individuals for years and popularized by the medical corps of the armed services during the recent war

When a case of the above type is admitted to the hospital the usually malodorous ointment dressing is removed employing aseptic technique, a wound culture and photograph are taken, and laboratory work in the form of a complete blood count, urine analysis, blood Kahn, plasma protein, albumin and globulin, and blood typing are ordered All crusts and necrotic tissue are then removed, the surrounding skin washed and shaved following which a *single layer* of *non-overlapping* 40 x 44 mesh plain sterile gauze is applied over the granulating surface This is followed by wet saline dressings Evaporation and capillary contamination are minimized by wrapping the part in sterile cellophane or similar moisture proof material The saline dressings are then changed every four hours down to the fine mesh gauze by the nursing staff employing sterile technique The fine mesh gauze is usually left undisturbed for one week unless necrotic tissue is present in which event it is changed every two days until all separating tissue has been removed

During this interval the patient's temperature usually returns to normal, his appetite improves and the blood picture is brought back to near normal by blood transfusions By the third hospital day the admission wound culture report is available and if this reveals pathogenic Gram positive cocci penicillin in the amount of 5,000 to 15,000 units may be added to each ounce of saline solution used If pathogenic Gram negative bacilli are reported one tenth to full strength Soluble Furacin Solution may be used to advantage However, neither is recommended for routine use since adequate drainage of the granulating wound will usually permit the tissues themselves to either destroy or effectively reduce the bacterial flora

On the seventh hospital day the patient is taken to surgery where under general anaesthesia the fine mesh gauze is removed, a check culture taken, all exuberant granulations cut down to a firm base and fresh sterile fine mesh gauze in a *single layer* reapplied and wet saline dressings every four hours resumed

* From the Dept of Plastic Surgery Southwestern Medical Foundation Dallas, Texas

The check culture is usually either negative or the number of bacteria appreciably reduced.

By the tenth hospital day the granulating bed is usually clean in appearance and ready for skin grafting. Under general anaesthesia the recently applied

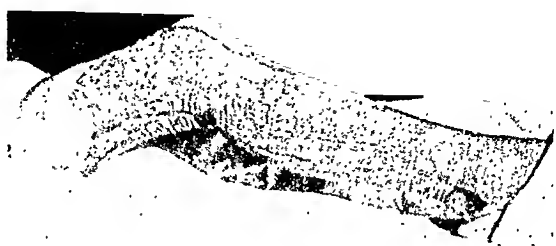


FIG. 1

FIG. 2

fine mesh gauze is removed, the part covered with hot saline packs and the grafts taken with a Padgett Dermatome. These are then placed upon the granulating bed and fixed in position with sutures and a pressure dressing over fine mesh vaseline gauze. An attempt is made to cover the entire area in one operation if the wound is not too extensive, the skin available and the condition of the patient permits.

If, however, the area *is* too extensive, such as two entire lower extremities, one will be grafted and the other kept clean for covering at an early date. Intramuscular penicillin in the amount of fifty thousand units every three hours is started the day before surgery and continued until the first post-operative dressing on the third post-operative day. At the time of this dressing all sutures are removed, any blebs, pustules or hematomata incised or excised and any

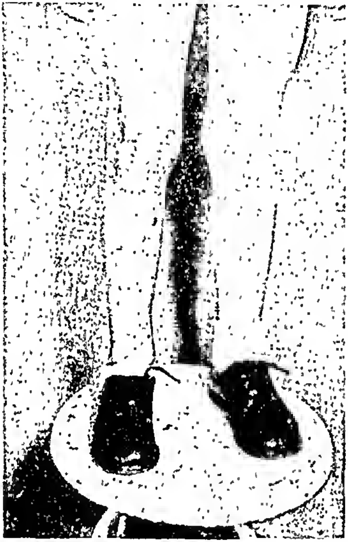


FIG. 3

necrotic graft or over-lapping graft edges excised. Fine mesh gauze is again applied in a *single layer* and wet saline pressure dressings instituted. These are changed down to the fine mesh gauze every twelve hours and continued for four to ten days as the case may warrant. All dressings can be discontinued by the tenth post-operative day if the "take" is in the "upper nineties." Any remaining granulating areas may then be strapped with adhesive tape until epithelization is complete. If the area grafted is a lower extremity an elastic bandage must be worn until the graft has adjusted itself to dependent circulation.

The cause of any appreciable loss of the graft will usually be found due to infection, hematomata or improper pressure and or immobilization in that order.

Fig. 4

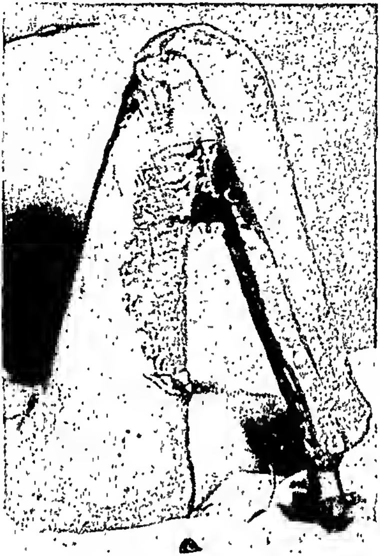


FIG. 6

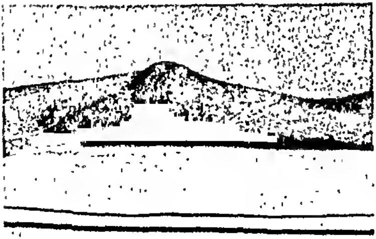


FIG. 7

PRESENTATION OF CASES

A. *Case No. I.* W. W. M. A six year old white boy burned May 25, 1947 and referred June 16, 1947. Figure 1.

Treatment: Necrotic skin removed and wet saline dressings over a *single layer* of fine mesh gauze started four hourly. Two 250 cc. blood transfusions. Fine mesh gauze changed the 4th and 8th hospital days

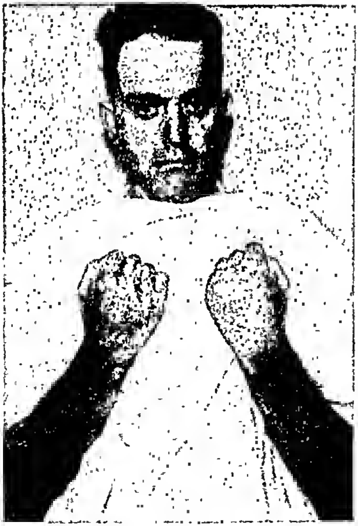
FIG. 8

FIG. 9

Operation: On June 27, 1947 six drums of skin totaling 160 square inches of .006 inch thickness were taken three from each thigh and sutured over the granulating wound of the right lower extremity. Figure 2. Pressure dressing and plaster immobilization. 500 cc. blood transfusion. Graft 98 per cent "take."

Discharged July 9th, 1947 on 23rd hospital day. Follow up on August 26th, 1947 shown in figures 3 and 4.

FIG. 10



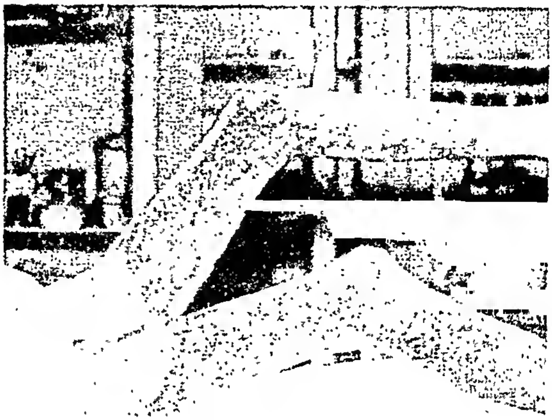


Fig. 12

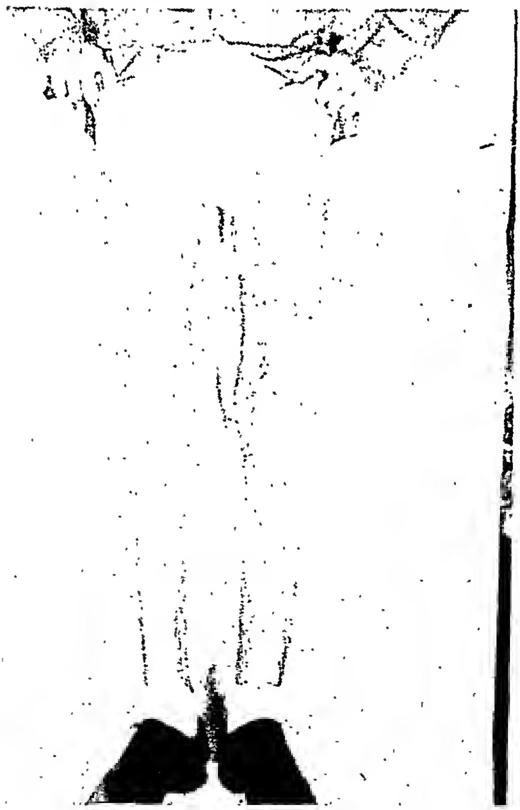


Fig. 13

FIG. 14

FIG. 15

B. *Case No. II.* R. E. S. A ten year old white male burned March 27, 1947 and referred April 19, 1947. Figure 5.

Treatment: Wet dressings of normal saline solution each four hours over a *single layer* of fine mesh gauze. Figure 6 Curettment of granulations and reapplication of fine mesh gauze April 22 and May 2, 1947 Kirschner wire skeletal traction through the os calcis started April 22, 1947. Three transfusions of 250 cc. citrated blood.

Operation: May 5, 1947 160 square inches of skin in eight strips of .006 inch thickness were taken from the left half of the body and sutured over the right thigh and knee. 250 cc. blood given. 98 per cent "take."

FIG 16

May 15, 1947 75 square inches of skin of 006 inch thickness were taken from the right half of the body and sutured over the right lower leg 250 cc. blood given. 95 per cent "take." Tub baths instituted.

June 3, 1947 10 square inches of skin of 006 inch thickness placed over four granulating areas of the right lower extremity. 95 per cent "take"

Discharged June 10, 1947 on 53rd hospital day as shown in Figure 7

C. *Case No. III.* J. E. S A 32 year old white male burned January 8, 1947 and referred February 8, 1947. Figure 8

Treatment: Wet saline dressings each four hours over a *single layer* of fine mesh gauze. On February 10, 1947 both hands were thoroughly cleaned, all fingernails avulsed, fine mesh gauze replaced and wet saline dressings resumed By February 17, 1947 epithelization was near completion, Figure 9, and saline baths were started.

Discharged March 5, 1947 on 25th hospital day without grafting Figures 10 and 11 show the result six months following discharge

D *Case No IV* G E W A 34 year old white male burned May 25, 1947 and referred June 25, 1947 Figure 12

FIG 17

FIG 18

Treatment Wet penicillin dressings (15 000 units per ounce of normal saline) each four hours over a *single layer* of fine mesh gauze because of Streptococcus Anhemolyticus culture report Fine mesh gauze changed and granulations curetted July 3, 1947

Operations July 8 1947 120 square inches of skin in six strips of 010 inch thickness from left half of body to cover the left lower extremity 1000 cc blood given 100 per cent "take"

July 15, 1947 192 square inches of skin of .010 thickness taken from the right half of the body to cover the right lower extremity. 500 cc. blood given. 85 per cent "take." Tub baths twice daily instituted.

August 3, 1947 16 square inches of skin was taken with a razor and used to cover multiple granulating areas on the right lower extremity. Figure 13 shows appearance August 20, 1947.

Discharged September 24, 1947 (90th hospital day) fully ambulatory after prolonged physiotherapy.

Fig. 19

E. *Case No. V.* C. E. B. A 10 year old white boy burned January 26, 1947 and referred July 2, 1947. Figure 14.

Treatment: On July 3, 1947 the granulations were curetted, a *single layer* of fine mesh gauze applied and four hourly wet saline dressings started. Four transfusions of 250 cc. each were given. The fine mesh gauze was changed on July 10, 1947.

Operation: On July 14, 1947 six strips of skin of .008 inch in thickness and totaling 160 square inches were taken from the thigh and sutured in place over the granulating wound of the back and right elbow. 500 cc blood given. "Take" as shown July 17, 1947 in Figure 15.

Discharged August 2, 1947 on the 31st hospital day. Final result as shown in Figure 16 taken October 1, 1947.

Fig 20

FIG. 22

FIG. 23

F. *Case No VI* J H A 34 year old negro male burned July 17, 1946 and referred January 31, 1947 Figures 17 and 18

Preparation Wet saline dressings every four hours over a *single layer* of fine mesh gauze and the legs elevated On February 6 1947 the cicatricial tissue which was one centimeter in thickness was excised, fine mesh gauze reapplied and wet saline dressings resumed Figure 19 Blood Kahn, Kline and Wassermann three plus

Fig 24

Fig 25

Operations On February 13, 1947 126 square inches of skin of 006 inch in thickness were taken from the abdomen and sutured in place over the granulating wounds of both lower extremities 500 cc blood given "Take" 90 per cent right leg and 75 per cent left leg

February 28, 1947 48 square inches of skin 008 inch thick were taken from the right thigh and sutured in place over the granulating surface of the left leg Eighty per cent "take"

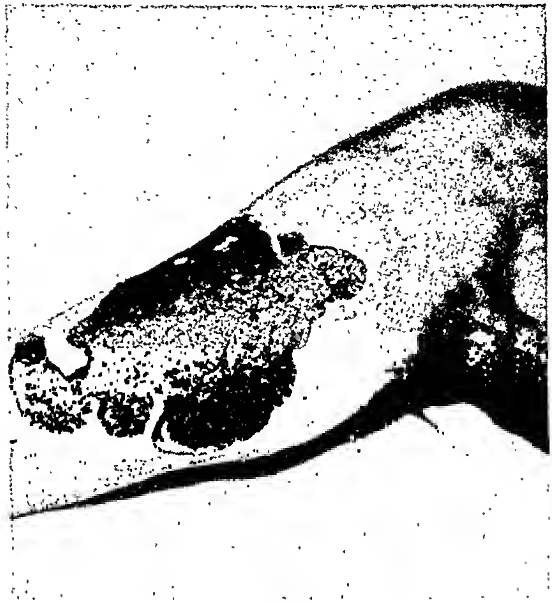


Fig. 26

Fig. 27

March 10, 1047 a third graft of 16 square inches to the left leg with 90 per cent "take" *Discharged* healed March 19, 1947 on the 47th hospital day The follow up photographs as shown in Figures 20 and 21 were taken June 25, 1947 No antiluetic therapy was given

G *Case No VII* K R S A 13 year old white male burned December 15, 1944 and referred January 8, 1047 after multiple attempted skin grafts and with a 90 degree flexion contracture of the right knee Figure 22

Preparation Wet saline dressings each four hours over a *single layer* of fine mesh gauze The granulations were curetted and the fine mesh gauze changed January 13, 1947

Operation On January 16, 1947 160 square inches of skin of 008 inch in thickness were taken from both thighs and sutured in place over the granulating wound of the right lower leg "Take" 100 per cent

Discharged on crutches, healed, January 25, 1947 on his sixteenth hospital day

This patient was again admitted July 7, 1947, Figure 23, and the flexion contracture corrected employing a relaxation incision, Figure 24, skeletal traction and a thick split graft Figure 25

H *Case No VIII* H G S A 29 year old white male burned in 1939 There had been twelve skin graft attempts prior to being referred to us on February 27, 1947 Figure 26

Preparation Wet saline dressings every four hours over a *single layer* of fine mesh gauze and elevation of the extremity On March 4 1947 the ulcer was excised, fine mesh gauze reapplied and wet saline dressings resumed

Operation On March 13 1947 64 square inches of skin of 010 inch in thickness were taken from the posterior aspect of the right thigh and sutured in place over the granulating wound of the left lower leg "Take" 95 per cent

Discharged March 23, 1947 on his 24th hospital day Result as shown in Figure 27 taken April 26, 1947

SUMMARY

The advantage of the fine mesh gauze treatment of granulating wounds are as follows

1 A *single non-overlapping layer* of fine mesh gauze allows the drainage of exudate through it into the overlying wet dressings which in turn can be changed *frequently* and relatively *painlessly*

2 Removing the granulations *prior to the day of skin grafting* results in a cleaner wound, a more receptive bed and *minimizes* bleeding beneath the graft

3 Changing the fine mesh gauze two or three days prior to grafting likewise minimizes oozing from the granulating wound when the gauze is removed the day the grafts are placed

4 Following skin grafting or in the treatment of cases such as presented in Case No III fine mesh gauze allows the spread of epithelium with a minimum of disturbance

5 All dressings other than the initial one, those in which the fine mesh gauze is changed and the initial post-skin grafting dressing can be done by trained hospital personnel

PLASTIC SURGERY IN FACIAL CANCER

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The treatment of extensive facial cancers should be a cooperative effort of several hospital staff services. In extensive lesions the subsequent task of the Plastic Surgeon can be helped greatly by the preliminary planning of the excision with the General Surgeon, who is to remove the lesion.

As an example, the excision of all lesions involving the mouth or nose should be so planned that excess mucous membrane can be brought out and sutured to the skin around the edge of the defect. This greatly facilitates the planning of inturned flaps which can be used to line the mouth or nose in the subsequent repair.

Incisions for gland resections should be made with the plan of the Plastic Surgeon in mind so that future flaps should not be endangered by cutting across their bases.

In the author's opinion, the radiologist, chemo-surgeon, or general surgeon should have the responsibility of curing the lesion and the Plastic Surgeon repair the defect. With such cooperation the General Surgeon would feel more liberty in going wide of the lesion if he is not confronted with the possibility of repair of a large defect and can shift that responsibility to others. This in itself should result in an increased number of cures because inadequate removal has frequently been disastrous.

In certain patients there are exceptions as in the removal of small skin lesions which are immediately sutured or covered with a small skin graft and then followed by x-ray or radium treatments.

As an example of the cooperation above mentioned, the author wishes to cite two cases, one treated by the radiology department and the other by the surgical department:

CASE 1: Miss F. D. developed a lesion under her right eye which was diagnosed as a cancer and treated for six years with deep x-ray therapy.

In 1945 the lesion was pronounced cured and she was turned over to the Plastic Surgery Division for Repair of the defect. (fig. 1)

On December 5, 1945, the mass of scar tissue, necrotic bone and lining of the antrum was removed and the antrum was packed with vaseline gauze. No malignancy found in this specimen. (fig. 1)

1st Stage Repair: On May 28, 1946, a pedicle was outlined on the forehead following a pattern designed to come down and cover the defect. The flap was elevated from the forehead and sutured back in place with subcuticular stitches (subcuticular stitches are used in exposed areas to avoid transferring "2nd hand stitch marks" to the grafted area). Following patterns, flaps were outlined around the edge of the defect on the cheek to be turned in as lining later. (fig. 2)

* From The Straith Clinic for Oral and Plastic Surgery, David Whitney Bldg., Detroit, Mich.

2nd Stage Repair: On June 22, 1946, flaps surrounding the defect were turned in and sutured together with catgut with the knots tied inside the antrum. The forehead flap was elevated and brought down to cover the defect and a Dermatome graft was removed from the thigh and sutured in place in the forehead defect. The sutures were left long and tied over gauze to produce pressure. The under side of the pedicle was also skin grafted. (fig. 3)

3rd Stage Repair: Four weeks later the pedicle was severed and the unused part returned to the forehead after removing the skin graft from its under surface. A few hairs remaining on the cheek flap were epilated by electrolysis. The forehead flap as usual is an excellent match for the facial skin. (fig. 4)

FIG. 1

FIG. 2

FIG. 1. RADIOLOGICAL CURE OF CANCER OF THE CHEEK AFTER SIX YEARS TREATMENT
NOTE EXPOSED BONE

FIG. 2 FOREHEAD PEDICLE OUTLINED, ELEVATED AND RESUTURED WITH SUBCUTICULAR SUTURES IN THE ANTERIOR AREA

Flaps around the antral opening have been elevated and resutured in old position to develop circulation in flap

CASE 2: Early History—About January, 1929, the patient, C. V. T., first noticed an ulcer in the right side of the cheek opposite some bad teeth. The teeth were removed. The Wassermann was reported negative. A positive Wassermann was reported later. A fissure developed in the ulcer which extended back into the cheek.

On August 1, 1930, patient appeared at the Harper Hospital Clinic and was sent into the hospital.

Examination August 1, 1930: Marked swelling in lower lip size of an acorn. Fissure extending from angle of mouth back two inches into buccal membrane, about ½ inch deep and appeared secondarily infected. (See fig. 5)

Biopsy was taken on entrance to the hospital and reported, "advanced squa-

Fig. 3

Fig. 4

Fig. 3. Forehead Pedicle Brought to Face and Sutured into Defect with Subcuticular Stitches—After Inturned Flaps had been Turned over and Sutured to Form Lining

Skin graft has been applied to forehead and held down by gauze dressing tied on with graft sutures. Under side of the pedicle has also been skin grafted.

Fig. 4. Result Six Months after Completion

The graft matches well, shows few stitch marks and has had the few isolated hair follicles epilated. Hair arrangement covers the small grafted area on the forehead.

Fig. 5

Fig. 6

Fig. 5. C. V. T. showing Lesion on Lip from Secondary Infection of Large Carcinomatous Ulcer Inside Mouth

Submaxillary glands very prominent

Fig. 6. Tube Pedicle has been Prepared over Right Deltoid Region

Glands have been resected from the right side of the neck. Note mucous membrane brought out to skin edges around the defect. Flap on chin has been elevated and resutured. (See Plate I, fig. 1.)

PLATE I

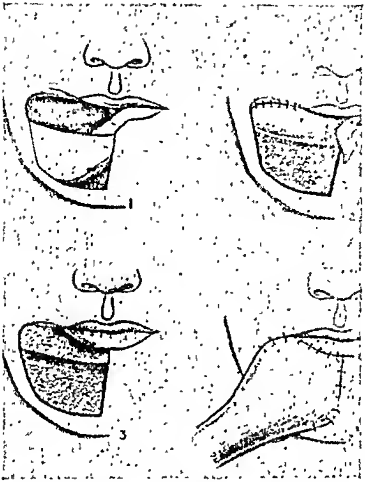

Plate I

Fig. 1. Inturned flap outlined and elevated—to be resutured in position.

Fig. 2. Inturned flap inverted and sutured to oral mucous membrane—red border flaps elevated.

Fig. 3. Red border flap sutured to inturned flap on posterior border.

Fig. 4. Deltoid pedicle sutured in place.

mous celled carcinoma, rapid growth, pearl formation, marked by lymphoid reaction".

On August 8, 1930, with the cooperation of Doctors Allen and Salot we made an excision of ½ the lower lip and cheek back to the molar region. The mucous membrane was brought out and sutured to skin all around the defect to facilitate use of surrounding skin as inturned pedicles to supply lining to mouth cavity. (See fig. 6)

On September 20, 1930, a block dissection of glands of the right side of the neck was done by Doctors Sterling and Salot.

Pathological report: Widespread metastasis in lymphonodes; none in salivary glands.

FIG. 7

FIG. 8

FIG. 7. DELTOID TUBE PEDICLE ATTACHED TO COVER LIP DEFECT
Plaster cast applied to maintain head-arm relationship. (See Plate I, fig. 4.)

FIG. 8. PATIENT 17½ YEARS AFTER REMOVAL OF HIS CARCINOMA

Three series of deep x-ray treatments were given by Dr. Lecutia. (fig. 6)

February 12, 1931—(six months after the tumor resection) a right Deltoid tube pedicle was constructed according to pattern. A flap was outlined on the lower lip, chin and cheek, dissected up to the base of the buccal sulcus and brought back and sutured in its original position again. (See fig. 1, Plate I) A small flap of mucous membrane from the medial edge of the lip was also elevated and sutured back in position. (See fig. 2, Plate I; see fig. 6)

March 8, 1931—The inturned flap was elevated from chin, turned in as lining and sutured to mucous membrane of the upper cheek defect. Mucous membrane flap was brought up from medial edge of defect and sutured to former flap along its posterior edge. (See fig. 2, 3, Plate I)

The distal end of the deltoid pedicle was brought up and sutured into defect as covering. (See fig. 4, Plate I, fig. 7)

PLATE II

PLATE II

Note . . . advancements of the surrounding
. . . ver lip the conspicuous graft was

April 1, 1931—The pedicle was severed from the chin and the unused portion returned to the shoulder.

As in all cases, foreign skin does not match the face and, therefore, the old Moristin method of skin stretching was brought into play.

In a series of four operations, the skin graft was gradually excised and the surrounding skin brought over to cover the defect. A naso labial flap from the right side was turned down to replace the remaining skin in the upper $\frac{1}{3}$ of the lip. Thus the entire mass of foreign skin had been removed and replaced with skin of similar texture and color. (See Plate II)

The patient has been observed frequently and has remained free from cancer for $17\frac{1}{2}$ years since his carcinoma was removed. (See fig. 8—completed case.)

CONCLUSIONS

1. Such cooperation between services in the treatment of cancer we believe is desirable and would increase the percentage of cures.

2. With but few exceptions, the Plastic Surgeon's function should be the correction of deformities rather than the cure of disease.

EYELID RECONSTRUCTION IN THE BLINDED*

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In the reconstruction of eyelids in blinded war casualties, the primary goal has been the rehabilitation of the orbit and lids to tolerate and retain an acceptable ocular prosthesis Of equal importance is the thoughtful selection of reparative procedures to reconstruct eyelids with adequate function, and appearance as normal as possible, but with planned consideration to minimize any further scarring from donor sites when adjacent pedicle grafts are required In many patients with eyelid wounds, there is serious cicatricial damage of surrounding areas, so the plans for reconstruction should include all the damaged structures Thus a comprehensive plan of repair will eliminate duplication of operative procedures and speed the rehabilitation of the patient

The criteria for successful eyelid reconstruction have been elaborated clearly by Spaeth, (1) Hughes (2, 3) and others When available and practical, the selection of eyelid skin, tarsus and conjunctiva for reparative lid surgery will provide the finest results The selection of other than lid tissues is dictated always by necessity and never by choice! Again it should be emphasized that in the presence of an intact functional eyeball, skin should never be grafted for conjunctival lining where it may cause corneal irritation and ulceration In this series of cases, however, either skin or mucous membrane could be utilized for lining since all the damaged sockets were surgically anophthalmic With no cornea to be protected, the demands were less exacting and some of the satisfactory results show lids of good appearance and position but frequently quite fixed and immobile

Whenever possible, excision and revision of contracted scar, with preservation and replacement of lid tissues, will provide the best reparative result as shown in figs 1a and 1b The tight scar has caused notching of both upper and lower eyelids but the conjunctival lining was adequate In repositioning the distorted upper lid portions, the tarso conjunctival edges were approximated with accuracy, the orbicularis muscle layer sutured separately, and the skin closed with 6-0 silk When cicatricial notching of the upper lid was adherent to the supra-orbital ridge, a small pedicle of adjacent subcutaneous tissue was interpolated into this area to prevent recurrence of the contracture and notching Likewise the thickened scar in the left inner canthal region and the notch of the left lower eyelid have been corrected

When the empty conjunctival sac is contracted by scar, as seen in figs 2a and 2b, more lining must be introduced A portion of thin split skin graft from the inner aspect of the upper arm proved adequate in supplementing the remaining

* Presented at the Fifteenth Annual Meeting of the American Society of Plastic and Recon[illegible] Mo , November 14 1946

† [illegible] N R [illegible] the Philadelphia Naval Hospital

conjunctiva. After elevation of the depressed left inner canthus, two acceptabel prosthetic eyes could be inserted and retained (fig. 2c). The intermixing of skin and conjunctiva for lining the right socket produced a continued purulent discharge of epithelial debris, as compared with the normal conjunctival lining of the left side.

In a similar case of contracted lining with more cicatricial deformity of the lids (fig. 3a), the replacement was made rather easily with two strips of split

FIG. 1a Notch deformity of both upper and lower right eyelids from contracted vertical scars with less scar deformity of the opposite side.

FIG. 1b. Appearance after correction of displaced lid structures, careful revision of scars and the insertion of a plastic ocular prosthesis.

mucous membrane secured from the lower lip. The drawing in fig. 3b illustrates the simple manner in which two inch strips of split mucous membrane were shaved from the flat surface of the lower lip following distension with procaine solution. Two good strips can be obtained from the lower lip and one or two from the upper lip when required. Healing of the lip is spontaneous, without suture, in 10 days and a second or third graft can be secured from the same areas within three to four week intervals. In this manner it would be possible to re-

surface an entire orbit with split mucous membrane Before insertion, the grafts were placed, raw side out on a stent mold, lightly covered with vaseline, and the results have been superior to the more tedious procedure of obtaining full thickness grafts from the inner surface of the cheek. Variations of the procedure consist in suturing one edge of a mucous membrane graft to the dissected lid margin and securing pressure with a small amount of fluff gauze packed over

FIG. 2a. LOSS OF BOTH EYES, WITH A TEMPORARY PROSTHESIS IN THE DEPRESSED LEFT SOCKET

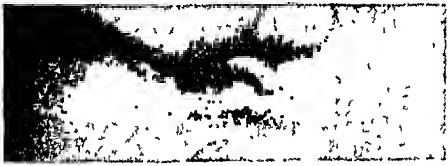

FIG. 2b. NEARLY COMPLETE CONTRACTURE OF RIGHT CONJUNCTIVAL SAC

FIG. 2c Additional lining on the right supplied by thin split skin graft to permit insertion of artificial plastic eyes Left inner canthus has been elevated

the graft The normal appearance of this lining is evident in fig 3c and the appearance of the prosthetic eye is seen in fig. 3d.

Obliteration of the inferior cul de sac by contracture of a dense mass of scar adherent to the underlying maxilla (fig. 4a) demands the complete resection of this cicatrix to release the lid border. An adjacent pedicle of skin and fat from the nasolabial fold, interpolated upward to cover the defect, provided surface coverage of good texture and color for the lower lid and cheek. The final view (fig. 4b) was taken two hours after insertion of the new prosthetic eyes, and the

Fig. 3a. Scar Contracture of Inner Half of Left Conjunctival Sac and Eyelids

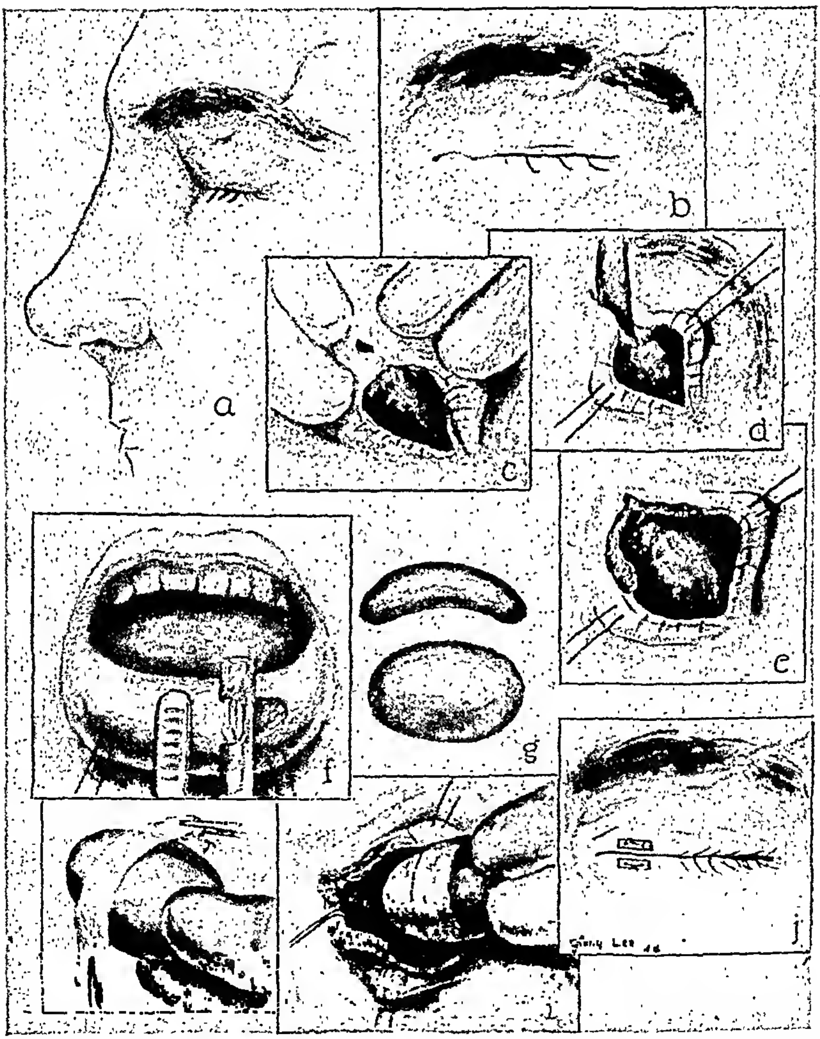

Fig. 3b. (a, b, c) Views of scar contracture of inner portion of left eyelids. (d, e) Separation of scar adhesion. (f) Split mucous membrane shaved from lower lip with razor blade. (g) Top and side views of stent mold. (h, i) Insertion of stent mold with graft covering inner end. (j) Mattress suture placed for retention of mold.

staring appearance should disappear after stretching and adjustment have occurred.

When the inner portion of a lower lid is missing (fig. 5a), it is possible to utilize the visible conjunctival surface by folding it upward and resurfacing this area with an adjacent rotated pedicle. Fig. 5b shows the manner in which a second pedicle was rotated upward immediately to cover this donor site and to interpolate good tissue between the lid and a contracted mass of scar. Later this scar was replaced by a free graft from the clavicular region (fig. 5c) and an eye

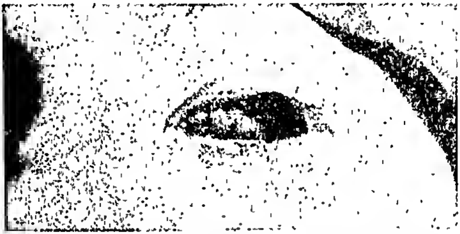

FIG. 3c. LINING SUPPLIED BY SPLIT GRAFTS OF MUCOUS MEMBRANE FROM THE LOWER LIP

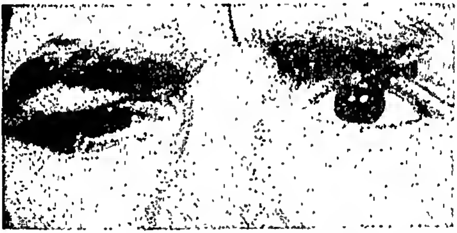

FIG. 3d. The plastic prosthesis is well tolerated. Some photophobia of the right eye accounts for the protective squint from the bright photographic lights.

lash graft inserted into the lower lid. Likewise the apparent increased distance between the eyes has been improved by the insertion of a cartilage graft on the depressed nasal bridge.

In a similar case with full thickness loss of the inner half of the lower lid (fig. 6a) all the available conjunctiva again was mobilized and the normal cheek skin widely undermined and advanced upwards. Fig. 6b indicates the manner in which the lid edges were sutured together and at a second stage the insertion of a free clavicular skin graft to decrease the tendency of retraction after lid separation. The routine use of a free skin graft in all cases of reconstruction

employing the split lid method, as demonstrated by Hughes, (4) has improved the appearance and position of the reconstructed lid. The final view of this case

FIG. 4a. LOSS OF BOTH EYES FROM SNIPER'S BULLET WHICH ENTERED RIGHT MALAR REGION

FIG. 4b. An ulcerated adherent mass of dense scar on left cheek obliterated the inferior fornix of the lower eyelid Excision and adjacent nasolabial pedicle graft are outlined.

FIG. 4c. Appearance after interpolation of pedicle upward to left inner canthus. Recent insertion of artificial plastic eyes, before stretching and adjustment of lids, accounts for staring appearance.

FIG. 5a. Full thickness loss of the inner portion of left lower eyelid, with surrounding scar and an adhesion holding the lids together.

shows an acceptable lower lid with a few lashes and minimal scar deformity of the cheek (fig. 6c).

When there is total loss of the lower lid, deformity of the upper lid and scar depression in the adjacent glabellar region of the nose (fig. 7a), some type of

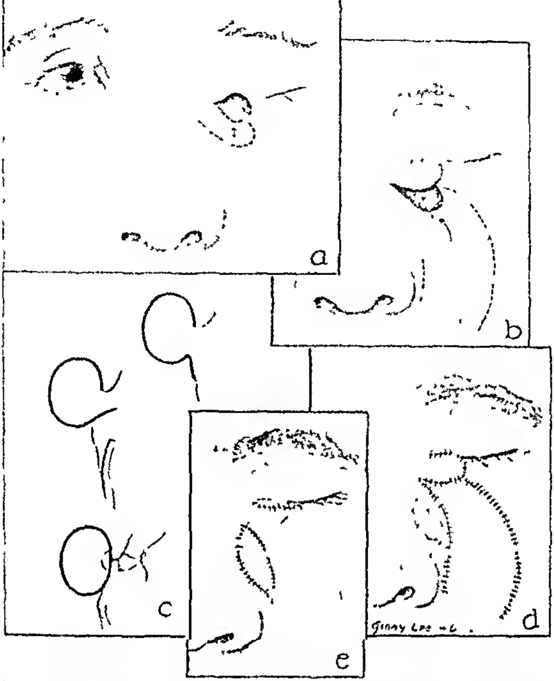

FIG 5b (a) Full thickness defect near inner canthus of left lower lid, adjacent pedicle undermined (b) Pedicle sutured over defect and second cheek pedicle outlined to be advanced upward (c) [illegible] conjunctiva is sutured [illegible] nt of adjacent scar by [illegible]

FIG [illegible] y adjacent rotated pedicle, utilizing exposed conjuncti[illegible] artificial eye in position and preserved cartilage graft f[illegible]

Fig. 6a. Full Thickness Loss of Inner Half of Left Lower Eyelid

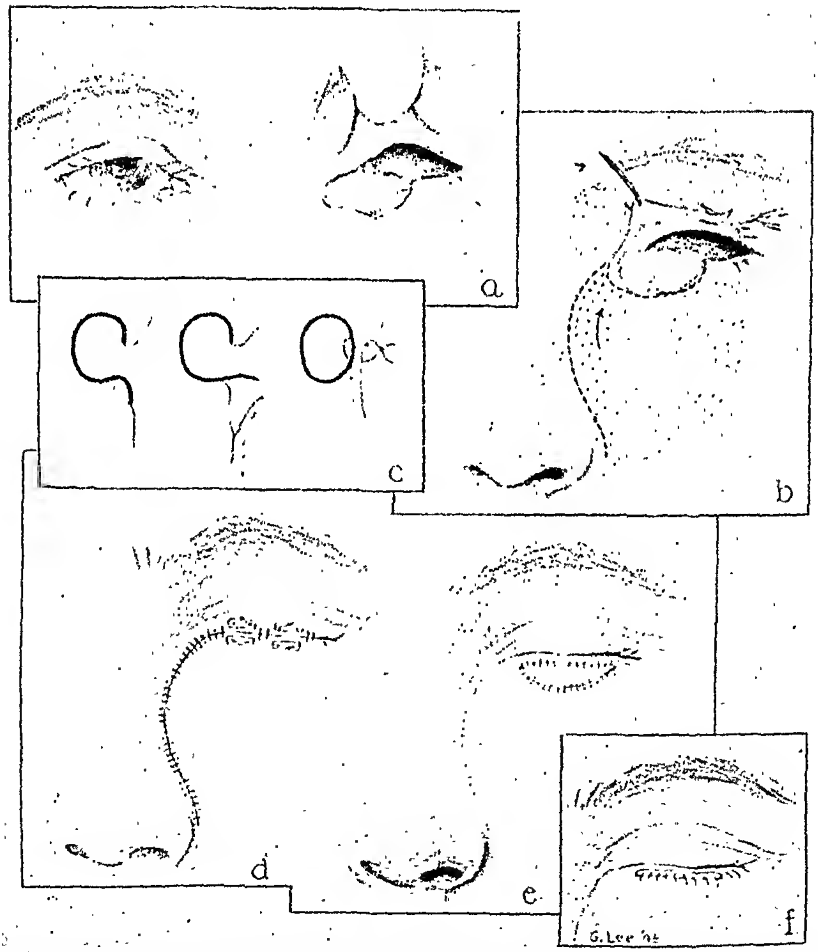

Fig. 6b. (a) Full thickness defect of inner half of left lower lid. (b) Cheek flap undermined for advancement upward. (c) Cross section showing utilization of exposed conjunctiva for lining. (d) Closure with lid adhesions. (e) Later insertion of free clavicular skin graft for improved relaxation. (f) Insertion of eyelash graft from eyebrow.

with the eventual
elashes are visible

FIG 7a Total loss of right lower eyelid, with extensive scar deformity of upper lid and bridge of nose

FIG 7b NASO ORBITAL FISTULA VISIBLE NEAR DISTORTED INNER CANTHUS

FIG 7c CONSTRUCTION ... BELOW THE HAIRLINE

FIG 7d ... CHEEK

FIG 7e Tubed pedicl ... preparatory to lower lid reconstruction

FIG 7f Appearance with ocular prosthesis in position and artificial eyelashes on upper lid Photophobia present in left eye

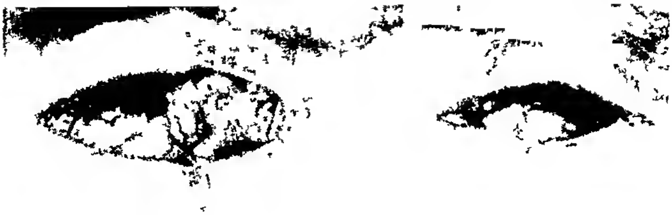

FIG 8a. Loss of both eyes, with destruction of inner canthal region on right side. Glabella region of nose eovered with depressed scar.

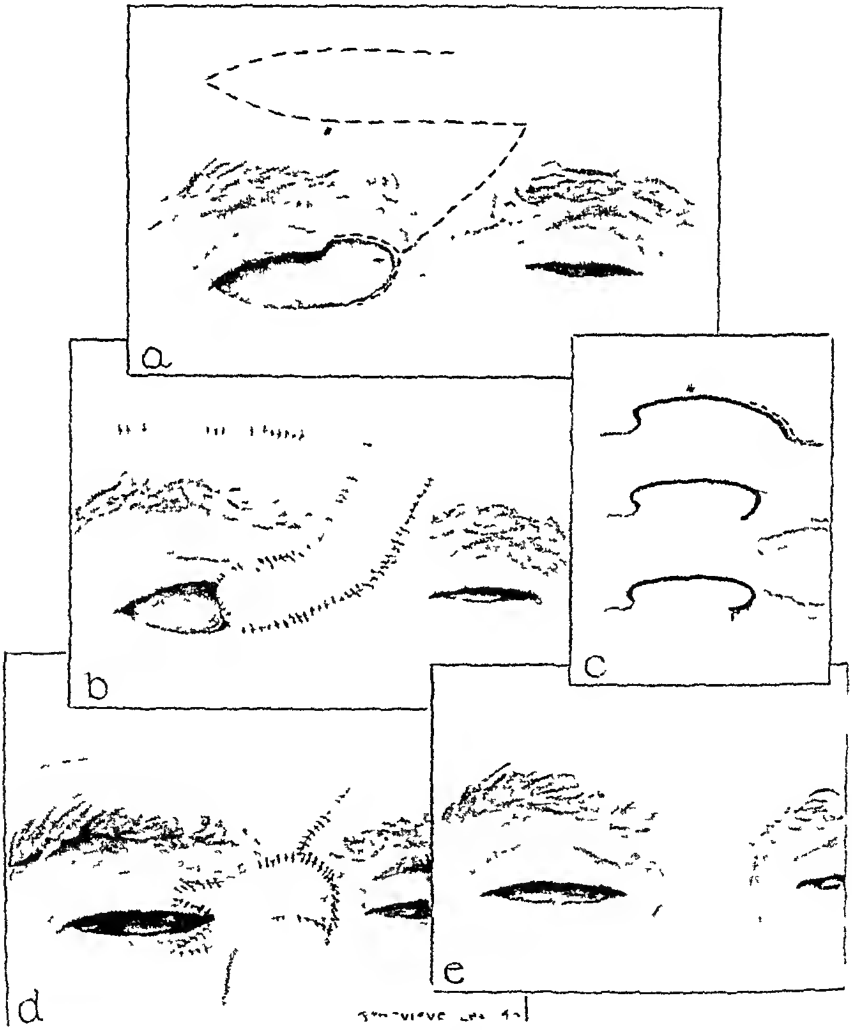

FIG. 8b (a) Defect of right inner canthal region and scar deformity of the glabella region of the nose Transverse forehead pedicle outlined (b) Transfer of forehead pedicle to cover inner canthal defect (c) Cross section showing exposed conjunctiva rolled inward for lining. (d) Revision of pedicle at inner canthus with transfer of pedicle base to replace glabella scar. (e) Final appearance after insertion of contour graft of preserved cartilage.

pedicle repair is indicated This becomes mandatory when a large orbital ethmoid fistula is present (fig 7b), because a larger portion of skin and subcutaneous tissue with sufficient vascularity is required in planning the entire reconstruction Thus a tubed pedicle was constructed below the bearded area on the neck (fig 7c), transferred to the right cheek (fig 7d), and later shifted to replace the scar in the glabellar region (fig 7e) There was adequate tissue to close the

Fig 8c Reconstruction of both areas by a transverse forehead pedicle graft with temporary prosthesis in position Later pedicle and adjacent scars were revised for improved appearance

Fig 9a Fig 9c

Fig 9a Total loss of right lower eyelid with bony destruction of infra orbital ridge, right malar region and bridge of nose

Fig 9c Final appearance after reconstruction with transverse forehead pedicle from above right eyebrow, and the insertion of preserved cartilage grafts to improve contour

orbital fistula and the replaced lower lid was lined with split mucous membrane The ocular prosthesis was retained well and the depressed glabellar region was rebuilt with preserved cartilage (fig 7f) When possible it is advisable always to close an orbital fistula into the nose to eliminate the profuse discharge from the irritated and infected conjunctival lining

In a similar defect of the inner canthus and glabellar region of the nose, but without an orbital fistula (fig 8a), a transverse or vertical forehead pedicle will

Fig. 9b

Fig. 9d

Fig. 9b. Profile view showing depression from loss of bone in infra-orbital and glabella regions.
Fig. 9d. Profile view showing improvement in contour of infra-orbital and glabella regions.

Fig. 10a. Extensive facial damage from gunshot wound, with opening into left antrum, total destruction of right lower eyelid and multiple deep pigmented scars.
Fig. 10b. Appearance (at time of arrival at Philadelphia Naval Hospital) after closure of left antral opening with a chest tubed pedicle graft.

supply the required tissue for repair. The drawings in fig. 8b, illustrate the manner in which a transverse pedicle was utilized for the reconstruction of both

the inner canthal and glabellar regions; the early post operative view (fig. 8c) shows the minimal scar of the donor site on the forehead. When it becomes necessary to introduce cartilage, bone or dermal grafts to improve contour, a

[illegible] upper lid tech- [illegible] Some edema

Fig 10d. Final view at discharge, after replacing dense scar of left cheek with a neck pedicle graft, and meticulous multiple revisions of the many pigmented scars

pedicle graft with subcutaneous tissue should be selected as surface covering, because free skin grafts can not be undermined widely with any degree of safety.

The same forehead pedicle method can be employed in cases of marked loss of tissue and bone in the infra-orbital region (fig 9a) In this instance the entire

lower lid was missing with the exposed conjunctiva pulled down on the cheek and there was a marked deformity of the glabellar region. The profile view (fig. 9b) shows the degree of bone loss in these areas. The lower lid was reconstructed with a transverse forehead pedicle from above the right eyebrow (fig. 9c), and lined with split mucous membrane from the lip. Later, cartilage grafts were inserted to correct the contour deformities of the infra-orbital and glabellar regions (fig. 9d).

The value of a comprehensive plan of reconstruction is best illustrated in this case of severe facial deformity (fig. 10a) where the complete loss of the right lower eyelid was only one important detail in this picture of extensive disfigurement. Previously, a pedicle graft had been applied to close the left antral opening, but the extensive scar of the entire right infra-orbital region is visible with no vestige of lower lid remaining (fig. 10b). After excision of the cheek scar, the normal tissues below were advanced upward and incorporated in the split lid technique for reconstruction of the lower lid by this method. Pedicle reconstruction of this lid—always a method of necessity and never of choice—was not required, since there was no subjacent bony deformity of this area. Again a generous free clavicular skin graft was inserted into the lower lid for relaxation of this reconstructed part (fig. 10c). Thus the reparative lid procedures were integrated into the operative plan of rehabilitation so that all phases were completed expeditiously (fig. 10d).

SUMMARY

In recapitulation, the following observations deserve serious consideration. When possible, the utilization of lid tissues for eyelid reconstructions provides the best results, and in the split lid technique the insertion of a free clavicular skin graft into the new lid improves its appearance and position. For more serious deformities involving bony loss, pedicle grafts are indicated and these are planned to minimize any scar deformity of adjacent donor sites. Split mucous membrane from the lips can be obtained simply and in adequate quantity to provide the preferred substitute lining even for the anophthalmic socket. A thoughtful, comprehensive and frequently cooperative plan of reparative surgery to include all damaged areas adjacent to or associated with eyelid deformities, will eliminate duplication of operative procedures and speed the ultimate successful reconstruction.

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ESTABLISHING A PRESERVED CARTILAGE BANK

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AND
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In plastic surgery the problem frequently arises of reconstructing features and contours that have been lost or are congenitally deficient Suitable soft tissue restoration has to be made with the patient's own tissue, but the support (or armature) such as that required for a nose, ear, or orbital border may be supplied from a stock source of preserved human cartilage Fresh autogenous tissues have advantages, but in a large series of patients it may not be expedient to open the thorax in every one, the costal cartilage being the main source of supply

A suitable extraneous substance possesses the following qualifications

1 It must be sterile

2 It must incite little or no tissue reaction

3 It must be readily available in large quantities and preferably inexpensive

4 It should be easy to work with and to carve Forms and molds made prior to operation serve as good patterns, but are often different from the shapes needed at time of operation The substance chosen must be of such a nature that it can be fashioned quickly and accurately

5 It should maintain the shape in which it is inserted Warping, curling, melting, and dissolving are undesirable qualities

6 It should be non absorbable

The list of substances which have been used in filling out contours includes such things as ivory, steel, gold, silver, tantälum, paraffin, rubber, wood, bone, glass, plastic, etc It is probable that cartilage fulfills the qualifications more than any other substance and is acceptable in the largest number of cases

Cartilage may be divided into three groups according to its source

1 Auto—that obtained from the same individual

2 Homo—that obtained from another individual of the same species

3 Hetero—that obtained from a different species

The third group probably can be negated as a source for successful implantation because these transplants are apt to be discharged rather violently

Hyaline cartilage has the widest variety of uses because of its availability in large quantities from the costal cartilages, but elastic and fibrous cartilage have been implanted successfully

The first experimental work on the transplantation of cartilage was probably done by Bert (1) in 1865 He concluded that a cartilage graft remained viable and was later converted to bone His experiments were all done on animals Koenig (2) is given credit for the first use of auto-cartilage transplants in the human Much investigative work has been done since that time even though there is still a divided opinion among plastic surgeons concerning the use of preserved homo-cartilage as opposed to fresh auto-cartilage

The advantages of preserved homo-cartilage are:

1. Its procurement does not require a major surgical procedure involving additional operating time and risk. Postoperative chest pain is also to be considered.

2. It is available in the quantity desired. The use of auto-cartilage in reconstruction of severe facial defects might require opening both sides of the chest and in children and small adults still be insufficient in amount.

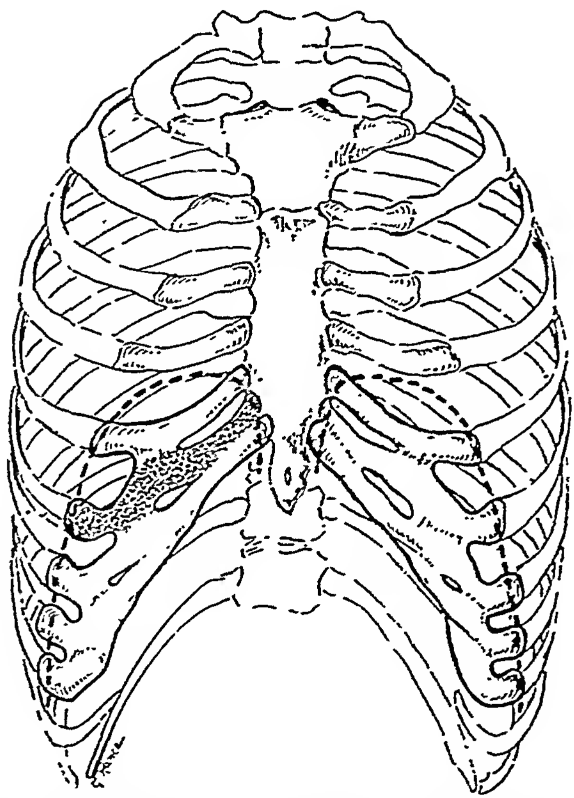


FIG. 1. Diagrammatic drawing of thoracic cage showing the source of costal cartilage. The heavy dotted line indicates the incisions made to obtain the maximum amount of cartilage. The stippled area indicates the costal cartilage of the sixth rib. This is the best source of cartilaginous angles.

3. The quality and shape of cartilage needed is available. For example, in nasal reconstruction an angle is often needed and definite width required. It is better to have a selection of material and to concentrate on giving the patient the best possible result than to try to get by on what one can find. The curvature of the chest in the region of costal cartilages in many individuals makes the desired angle rare. Also in cases in which length is needed, as in building out the contour of a mandible, a small person would be quite inadequate in cartilage. The nature of the cartilage itself has to be considered. If the patient's own cartilage is partially calcified or has large vacuolated areas it is undesirable.

4. It maintains the shape in which it was inserted. The tendency of fresh auto-cartilage to curl has ruined many a result that looked perfect at time of

FIG. 2. Costal cartilages before cleaning. The costal cartilages from three individuals are shown. The 5th, 6th, 7th, and 8th furnish the desired cartilage.

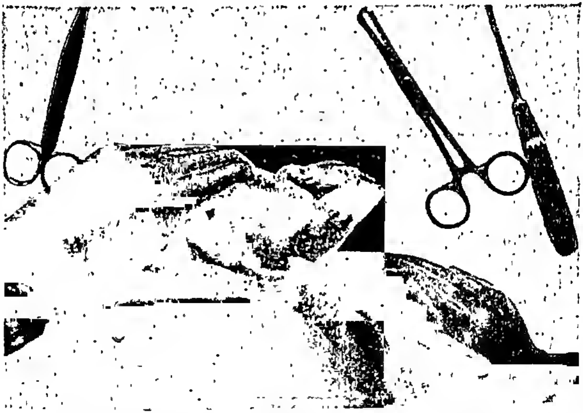


FIG. 3. Cleaning the cartilage: an incision is made along the length of the cartilage just through the perichondrium.

operation. Some curling in cartilage used in ears is not objectionable if it can be planned for the curling to be outward from the skull. If there is a tendency

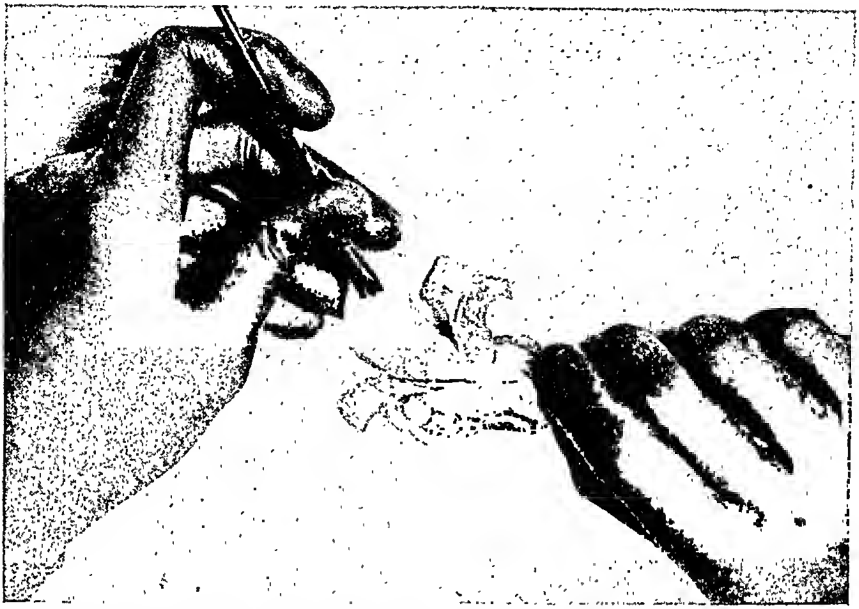


FIG. 4. The perichondrium is stripped cleanly from the cartilage by means of a Joseph nasal periosteal elevator. After a start has been made, the perichondrium can usually be stripped cleanly by holding one end with the tenaculum and making traction on the perichondrium.

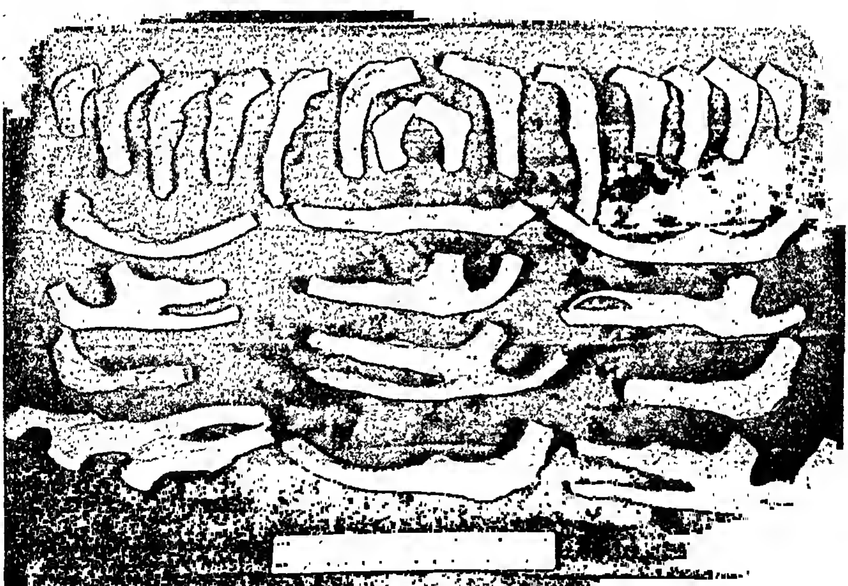
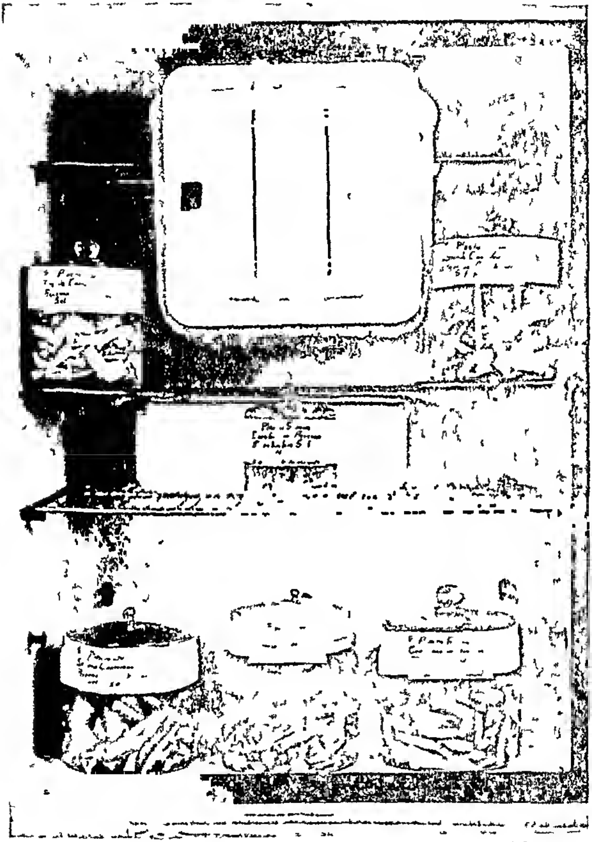


FIG. 5. Variety of preserved homo-cartilage available. Both quality and quantity needed are shown. At top of illustration are angles used mainly in nasal reconstruction. At bottom is seen the type of cartilage desirable in jaw reconstruction. Note length. Some pieces measure over six inches. These would be very difficult to obtain at time of operation.



...as to the ... solu-
tion turns pink and turbulent after a few days, the cleaning was inadequate

to curl or warp in homogenous cartilage, this usually has been entirely spent during the period of preservation

5. Because of availability it can be used as a temporary prosthesis or as a pattern for the later permanent implant.

6. Sliced, chipped, diced, and grated cartilage way be prepaired from this preserved material and used as desired.

The disadvantages are:

1. There is more likelihood of absorption than of fresh auto or homo-transplants, (3, 4) however, many preserved cartilage transplants retain their size and shape for long periods (5–7).

2. It may not be esthetic to a patient to have foreign cartilage implanted, but this usually can be allayed by properly informing the patient.

3. The preservative used for the cartilage may cause a reaction in the recipient's tissues.

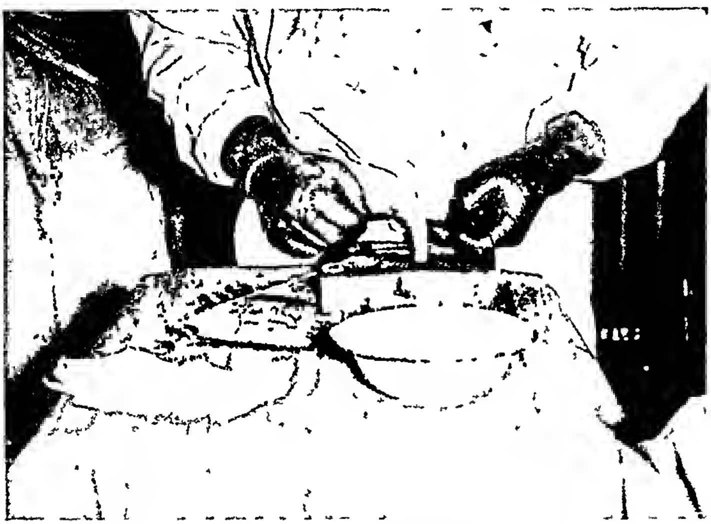


FIG. 7. Photograph showing fashioning of L-shaped nasal cartilage at time of operation.

On a large plastic service it is advisable to have on hand a large supply of preserved cartilage. This is kept in the form of a cartilage bank. The steps in the establishment of such a cartilage bank are:

1. Procuring the cartilage,
2. Cleaning and preparing the cartilage for storage,
3. Selecting a suitable preservative, and
4. Maintaining a system of storage and bacteriological study.

Procuring the cartilage may seem an insurmountable task, but perseverence and cooperation with a pathology department are requisite. One must be present at fresh autopsies and show a keen interest in the taking of the cartilage. The usual autopsy incision to enter the thoracic cage follows the lateral portion of the sternum through the costal cartilages and at its inferior portion goes directly through the best source of cartilaginous angles. It may be difficult to persuade the pathologist to make the opening more laterally.

FIG 8

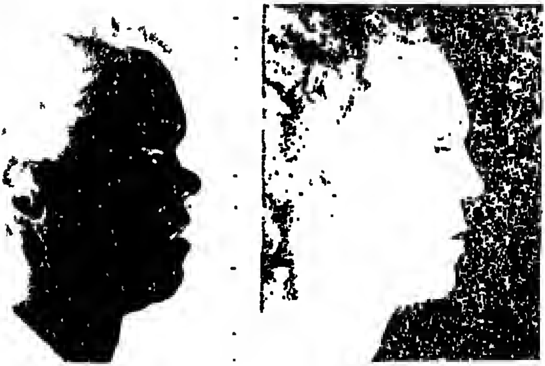


FIG 9

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The ideal situation would exist if the pathologist would permit the taking of the cartilage under sterile conditions. However, this will rarely occur and the next best thing is to take the cartilage under the cleanest possible conditions.

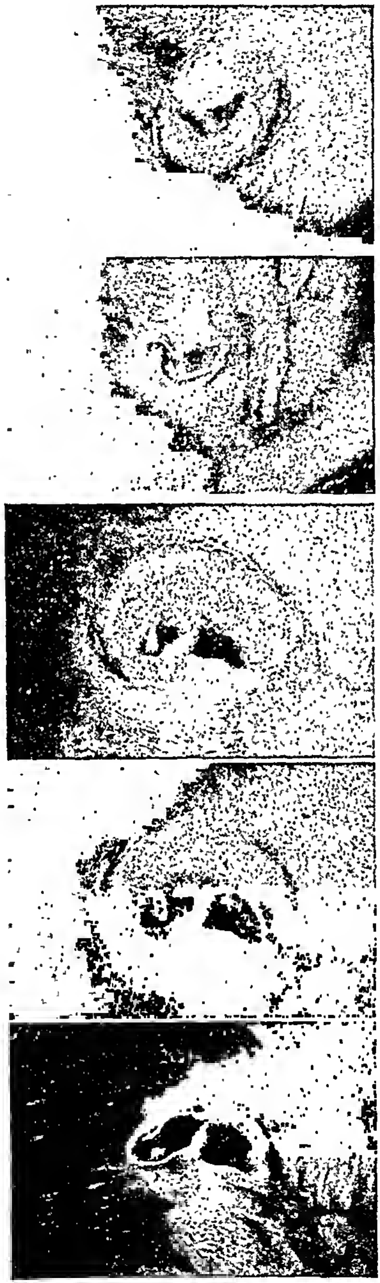
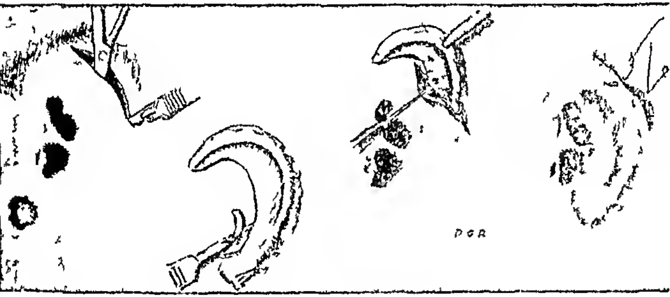


FIG. 10. Total loss from exposure to cold. Substitution done in 3 operations using local flap, single large piece of preserved cartilage and free split skin graft. Both ears in same condition repaired in same manner at same operation. (From Surgery, Gynecology and Obstetrics, Vol. 84, Feb. 1947.)

The cartilage can be placed in a sterile container in a freezing unit until ready for cleaning The preservation by antiseptics before cleaning is not generally satisfactory

The selection of suitable patients for the taking of cartilage is also important The age of the patient should be between seventeen and forty five Below seventeen the cartilage is too small and is more easily absorbed and over forty five it becomes yellow, brittle and frequently calcified Cartilage should not be taken from patients who have had chest infections positive serology, contagious disease or bacteremia

The cleaning and preparing of the cartilage involves manual labor but it is the most important step in the whole procedure of establishing a bank It is emphasized that all perichondrium is to be removed before placing in the preserving solution The instruments needed are Two tenacula (two to three teeth preferred), one Joseph elevator, scissors, cartilage knife, two Ochsner clamps and a wooden block These instruments are sterilized The tables to be used are draped with sterile sheets and the person who is to clean the cartilage puts on cap, mask, sterile gown and gloves The frozen cartilage is then placed in a basin of sterile saline The total removal of the perichondrium is best done by making an incision just through the perichondrium and elevating it along the incision The underlying cartilage can thus be exposed without damage The Joseph nasal periosteal elevator has proved invaluable in this operation Once a start has been obtained the entire perichondrium can usually be stripped off The tenaculum is used to hold the cartilage firmly without damaging it Junctions between the costal cartilages are not preserved unless the bridge between is actually cartilage or is calcified A fibrous junction can harbor



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bacteria. After each piece is cleaned it is placed in a basin of sterile saline. The entire lot is then rinsed with saline before storage in the preservative.

The preservative must possess bacteriostatic and bacteriocidal qualities and must be non-injurious to living tissues and not incite reaction. Several means of preservation have been used such as freezing, desiccating, boiling in merthiosaline, immersing in alcohol and in various antiseptic agents. Mercurial antiseptics have proved efficient and one method is to first place the cartilage in a sterile glass jar containing 1:100 aqueous merthiolate solution, with at least an inch of solution over the cartilage. The top of the jar is then sealed on with tape, the jar labeled, and placed in the refrigerator where it remains except while taking cultures, changing the solution, or obtaining cartilage for use. The solution is changed in a week and at the end of two weeks, it is then ready for

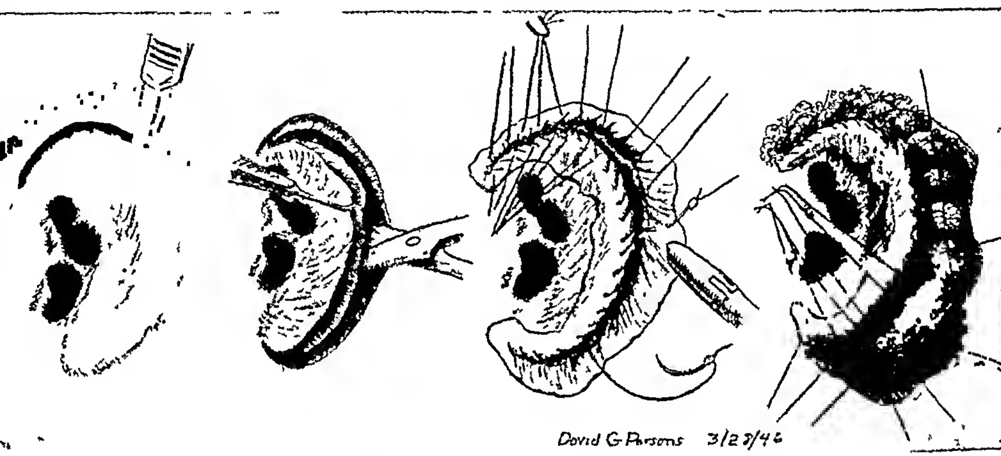

FIG 12. After the cartilage is firmly in place, the ear is cut loose from the scalp with careful dissection to leave viable soft tissue on both the cartilage and the skull. The double surface defect is covered with a thick split graft as shown. (From Surgery, Gynecology and Obstetrics, Vol 84, Feb 1947)

use if cultures are satisfactory and is placed in 1:5000 aqueous merthiolate. This weaker solution is used as the maintaining solution in order that the amount of preservative inserted at time of operation may be minimized. This solution is changed every two weeks at which time cultures are taken

Fresh lots of cartilage are never placed with older cartilage until they have been preserved for the prescribed length of time. In cases where several pieces are removed for selection at operation, but not used, they are put in a separate jar again in 1:1000 merthiolate for two weeks. It would be preferable to have a separate container for every piece that is to be stored. At time of operation the cartilage is washed in saline. Cartilage stored in this manner can be used as long as two or more years but should not be used if it has been in the solution less than two weeks.

Bacteriological studies are carried out best by taking the first culture before

placing in the 1 1000 merthiolate then at the end of the first and second weeks and every two weeks thereafter To get a representative culture several pieces of cartilage should be planted in a broth These are obtained by using a sterile knife and forceps and cutting several small chips off different pieces in the same jar Positive cultures should be very rare but in cases in which they occur the entire jar is quarantined and placed again in 1 1000 merthiolate for at least two weeks and two negative cultures

SUMMARY

A method of organizing a preserved homo cartilage bank has been presented for use in conjunction with plastic surgery procedures Appropriate cartilage is obtained at fresh autopsies, it is refrigerated (frozen if possible), thoroughly cleaned and again refrigerated in a solution of aqueous merthiolate Systematic bacteriological studies are made The advantages and disadvantages of preserved homo-cartilage were outlined

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SURGICAL MANAGEMENT OF CUTANEOUS POSTDIPHTHERITIC ULCERS

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This report of our experiences in the use of several surgical methods of treatment for indolent or recurrent cutaneous postdiphtheritic ulcers which failed to heal as a result of other therapeutic measures is a supplement to the principal study carried out by Livingood, Perry and Forrester (1) who reviewed the clinical aspects of 140 cases of cutaneous diphtheria admitted to an overseas Army hospital. It refers only to primary diphtheritic infection of the skin and is not concerned with diphtheritic infection of surgical wounds ("wound" diphtheria).

Cutaneous diphtheria occurred chiefly in soldiers living under jungle, field or combat conditions where bathing and changes of clothing were infrequent luxuries and where nutrition was often inadequate. Many of the patients gave a history suggesting that small cuts, leech bites or abrasions were present for several days before they became infected with C. diphtheriae. The diphtheritic lesions occurred over the entire cutaneous surface but were most common on the lower part of the leg, ankle, foot and hand. They were often multiple. Those on the distal part of the lower extremity were the slowest to heal. Virulent organisms of C. diphtheriae were isolated in 80 per cent of 109 patients in whom the disease was active at the time of admission. Faucial diphtheria did not appear on the cutaneous diphtheria wards, and repeated throat cultures of personnel and patients were all negative. Livingood and his associates (1) emphasize that the history and physical signs are so characteristic that the diagnosis can nearly always be made purely on clinical grounds. This is important if diphtheria antitoxin is to be given promptly. The time needed for bacteriological confirmation means a delay of several days, and the experienced observer does not need to await a final culture report or virulence test.

The acute lesion begins as an ulcer covered with a gray membrane which may be peeled off revealing necrotic corium (fig. 1). The corium later becomes a black adherent eschar which can be removed only by cutting with scissors or knife. Healing takes place centripetally. The subsequently formed scar is characteristic, with a smooth, pink, depressed center and raised hyperpigmented periphery. In contrast to ulcers due to other causes where closure is greatly facilitated by contracture, it does not contract centrally, and the final scar is identical in size with the original lesion. The adjacent skin is normal in color but is firm, unyielding and not easily wrinkled. Often there is a central ulcer which fails to heal (fig. 2). Moreover, in many cases which are apparently healed, a bleb will appear on the surface of the scar either spontaneously or as

the result of slight trauma Then the entire area of regenerated epithelium breaks down once more This type of recurrent ulceration occurred in 20 per cent of our cases This unusual characteristic is perhaps explained by the microscopic picture which shows massive fibrous tissue formation enclosing vessels which are surrounded by round cell exudate so abundant that the lumens are nearly occluded The scar extends peripherally beneath the normal skin

FIG 1 Removal of necrotic corium from acute diphtheritic ulcer of leg of 12 days, duration Negative # A44756 Army Institute of Pathology

beyond the ulcer for 2 0 to 3 0 mm and also downward into the subcutaneous fat After many months the round cell exudate becomes organized, but a few of the cells persist (fig 3)

COMPLICATIONS

Local

Failure of healing and recurrent ulceration were the most commonly occurring complications The consequent disability prolonged the illness so that the

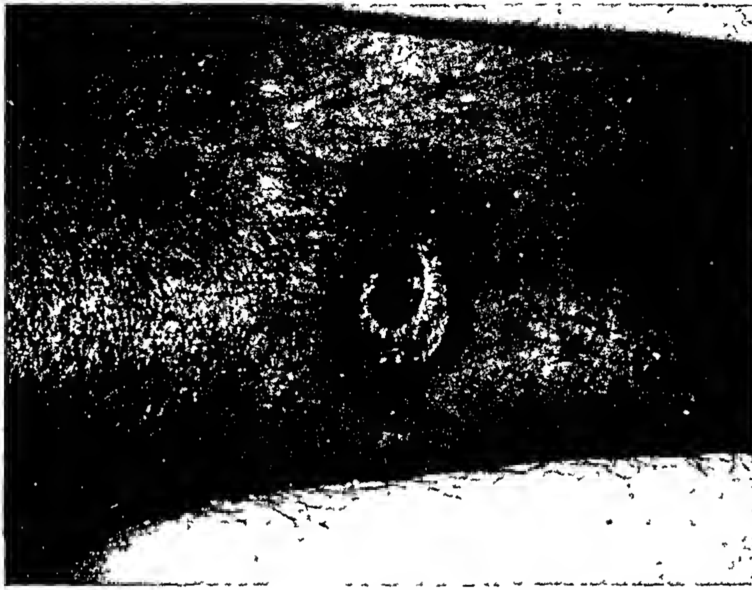

FIG. 2. Postdiphtheritic ulcer of leg unhealed after 5 months (center of the 3 lesions). Note the scarred depression in all 3 lesions, indicative of the extent of the original area of ulceration Negative #A44884, Army Institute of Pathology.

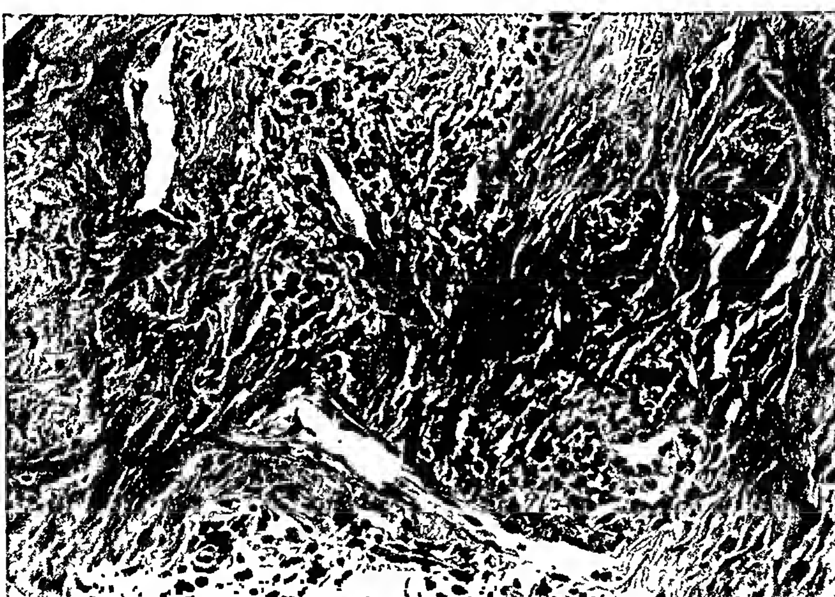

FIG. 3. Photomicrograph of tissue from Case I Postdiphtheritic ulcer of one and one-half years' duration, showing persistent perivascular round cell exudate in an organized stroma.

hospital stay for the entire group averaged 120 days The ulcers of 6 patients were unhealed after 6 months

Systemic

The gravest complications were those affecting the nervous system and heart Central and peripheral neurological changes were noted in 34 per cent (2) Five per cent developed cardiac complications (3) One patient died as a result of diphtheritic myocarditis

TREATMENT

Specific

The early administration of diphtheria antitoxin is, Livingood and his associates (1) believe, the most important single therapeutic measure Fewer complications occurred in patients who received antitoxin within 32 days after onset of the ulcer than in those who received it after that period, and slow healing and ulceration were much less common The poorest results were in those who did not get antitoxin at all The maximum response was obtained when it was given within the first week When administered parenterally penicillin assisted in reducing pain and clearing secondary infection, but it did not otherwise change the course of the disease

Local

Various methods of local treatment were employed, but none of them was very effective The drugs used included zinc peroxide, potassium permanganate, penicillin, local sulfonamide, application of mercuric chloride and saline soaks Of these zinc peroxide was the best Frequent soap and water washings, general cleanliness and treatment of local fungus infection were considered essential Antitoxin was of no more value when injected locally than when injected into the buttock

Surgical

Excision of the acute lesion was not attempted in this hospital Two patients so treated were admitted from another installation One wound had been unsuccessfully grafted and the other left open Even though both received antitoxin soon after onset, healing was greatly delayed beyond the time expected for lesions of this group Consequently we hesitated to treat any patients in this manner Twelve patients with 16 chronic ulcers were operated upon in this installation Excision of the ulcerated area and a small cuff of adjacent skin was performed on all patients and the defect was repaired in 1 of 3 ways 1 by sliding flap with relaxing incisions covered with grafts (1 patient), 2 by extensive undermining to reduce tension following by simple closure (10 ulcers in 8 patients), and by application of split-skin grafts (5 ulcers in 3 patients)

RESULTS

Excision with Closure by Sliding Flap and Grafted Relaxing Incisions

The 1 case done by this method was unsuccessful. The closure in the region of the ulcer broke down, healed and then recurred while the patient was still bedfast. Evacuation to the Zone of the Interior was eventually necessary. The grafted areas of the relaxing incisions healed uneventfully

Excision and Primary Closure (10 Ulcers, 8 Patients)

Even after thorough undermining and approximation of skin without undue tension, wound healing was poor and central ulceration in the region of the former ulcer developed in all patients post-operatively. Four of the ulcers healed

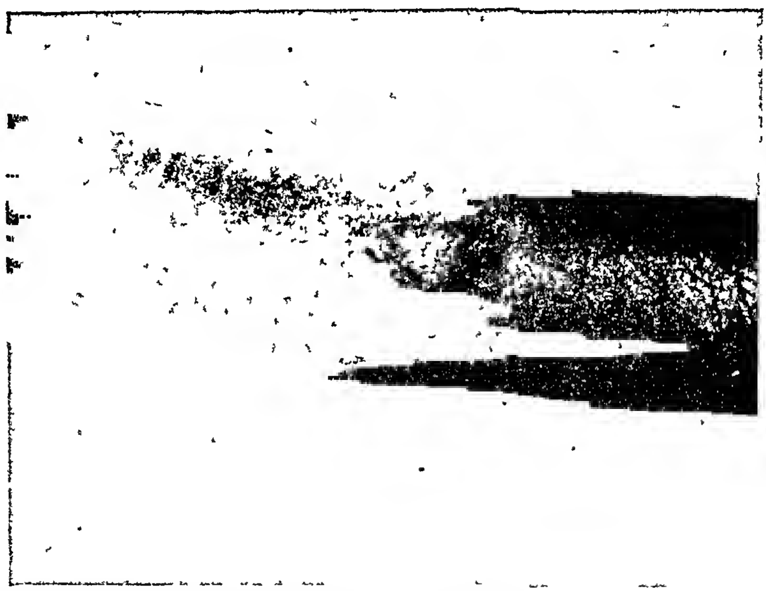

FIG. 4. Postoperative result of excision and split-skin grafting. Same patient as in figure 2. Negative #A4533, Army Institute of Pathology.

temporarily only to recur after the patients had undergone short periods of activity.

Excision and Split-Skin Graft

In the 5 ulcers so treated (3 patients) the results were successful (figs. 4 and 5). There was retarded healing in 2 of the grafts, but when it finally occurred, the surface was smooth and firm. Although 1 of the grafted patients was sent to the Zone of the Interior for a reason not related to the ulcer, the others returned to duty and were able to carry out their work without recurrence of the lesion.

It is noteworthy that in every one of the grafted patients after operation the

skin adjacent to the ulcer became much more pliable and soft and could be easily wrinkled. The explanation for this is not known. This was not true in those treated by the other methods. The patients themselves were conscious of the *difference and originally called it to our attention.*

We have recently had the opportunity to follow 1 additional patient, a former army nurse previously assigned to the cutaneous diphtheria wards of the hospital. Her protocol was not included by Livingood et al. (1) because the patient was not observed long enough at the time of their report.

Case 1. The history is as follows: In August 1944, 3 small skin ulcers appeared over the lower anterior surface of the left leg. She had been actively participating in the treatment

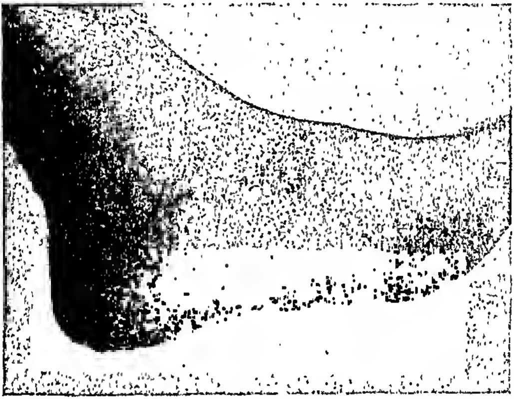

FIG. 5. Final result of excision and split-skin grafting of postdiphtheritic ulcer of instep which had existed for 90 days. Negative #A45476, Army Institute of Pathology.

of patients with cutaneous diphtheria. The central 1 of the 3 ulcers never epithelized, and the other 2 alternately healed and broke down upon slight trauma. Numerous local measures were employed without beneficial effect. The patient was next seen 1 and one-half years later in January 1946 at the Hospital of the University of Pennsylvania after she had returned from overseas' duty and had been separated from the service. The 3 scars at this time were ulcerated and the peripheral skin firm and not easily stretched (fig. 6). On January 26, 1946, the 3 lesions were excised and a split skin graft applied. There was 100 per cent "take" (fig. 7). The patient was examined in May 1946, 4 months after operation, and the wound was seen to be completely healed. It was noted that the previously inelastic surrounding skin had become soft and pliable. Eighteen months after operation the patient reported that there had been no recurrence of ulceration.

This patient's course emphasized the persistent nature of the ulcers and their refractoriness to conservative methods of treatment. Simple excision and skin grafting permitted permanent wound healing.

DISCUSSION

No mention of surgical treatment of persistent cutaneous postdiphtheritic ulcers was found in the literature. Failure of healing was a major cause of disability in our patients, but its importance apparently has not been recognized. The full report of cutaneous diphtheria in the South Pacific by Liebow, MacLean, Bumstead and Welt (4) and a recent War Department Technical Bulletin (5) do not mention the use of any sort of surgical therapy, nor do they emphasize prolonged disability from failure of ulcers to heal.

FIG. 6. CASE I POSTDIPHTHERITIC ULCERS OF LEG OF ONE AND ONE-HALF YEARS' DURATION

Operation was resorted to in only 12 of our 140 patients (8.5 per cent). Our failure to treat more cases surgically was due to the fact that, since we had no previous experience with this disease, we thought that the lesions would heal permanently without operation. After we had followed the patients for prolonged periods and discovered the frequent tendency of the lesions to recur, it

was our opinion that more of them should have been excised and grafted It would have resulted in a larger proportion of men being returned to duty and in reducing the period of hospitalization

In the patients treated surgically the average age of the lesions was 145 days, varying from 89 to 204 days Our experience suggests that this was too long

FIG 7 CASE I EARLY RESULT 12 DAYS AFTER EXCISION AND SPLIT SKIN GRAFTING

to wait If a lesion has not healed after 60 to 70 days, further medical measures are ineffective and operation should be considered

Our series of patients is too small to provide conclusive support for any method of surgical treatment, but it is our belief that the best procedure is to excise the ulcer with a surrounding cuff of skin and to cover the defect with a split-skin graft

Biological factors in wound healing must not be overlooked In a patient with anemia and hypoproteinemia and associated hookworm infestation the postoperative wound failed to heal until these factors were recognized and

corrected. Adequate feeding of protein and transfusions of blood and plasma were necessary in some patients. We did not recognize vitamin deficiency clinically in our patients, but avitaminosis was not uncommon in that part of the world.

These ulcers present an entirely different problem in wound healing from the usual cutaneous defect after a wound. In a series of 200 battle casualties from the same combat units which supplied the cases of cutaneous diphtheria, early secondary closure (4 to 12 days) was successful in 90 per cent. The failure of the diphtheritic lesions to heal was probably related to their histological structure which has been described earlier in this paper. The tissue around the lesion is inelastic and poorly supplied with blood due to fibrosis and perivascular round cell exudate.

SUMMARY

One hundred and forty cases of cutaneous diphtheria were seen in one Army hospital. The cutaneous ulcerations were indolent and even after primary healing tended to recur. Twelve patients (16 ulcers) were operated upon after an average period of 145 days. On the basis of our observations we recommend the following:

1. Do not excise the ulcer during its acute stage.
2. Consider operation if the lesion has not healed in 60 to 70 days.
3. Best results will probably be obtained by excising the ulcer and a small cuff of skin followed by application of a split-skin graft.
4. Hypoproteinemia, anemia and vitamin deficiency must be sought for and corrected since it is only with the optimum care that these lesions will heal.

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EXPERIMENTAL AND CLINICAL STUDIES OF REDUCED TEMPERATURES IN INJURY AND REPAIR IN MAN[1]

III. Direct Effect of Cooling and Freezing on Various Elements of the Human Skin[2]

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The present report covers a special phase of the general investigative project dealing with the experimental and clinical study of the effect of reduced temperatures on injury and repair of human tissues (1, 2). Exposure of living tissue to the different temperatures produces alterations in the rate of metabolic processes depending upon the action of temperature on the rate of chemical reaction, and nature and rate of enzyme action. Temperatures drastically different from those of the normal environment of the particular organism, in addition to affecting the metabolism, introduce alterations of structural configurations of the cellular protoplasm. Freezing, for example, produces physico-chemical changes of colloidal systems entailing dehydration, splitting of radicals and denaturation of proteins (1). Thus, when a portion of the human body is exposed to the influence of reduced temperatures (e.g. chilled or frozen) the local metabolic rate will be proportional to the level of temperatures and will prevail as long as that temperature is maintained, but the sequelae due to the physico-chemical alterations of living matter may become apparent only after restoration of the part into the "normal" environment.

These effects may be considered as "direct" and, as we have pointed out in a previous report (1), influence all tissues and underlie all reactions that follow exposure of living human tissues to the action of reduced temperatures of various degrees. In the skin for instance, the "direct" damage due to cold might be the same to both endothelial cells of the subepidermal capillaries and to the epithelial cells of the overlying epidermis, but the leakage of plasma that follows even partial damage of the capillary endothelium may so impair the exchange of gases and metabolites that many epithelial cells which had been only partially damaged are completely destroyed. Thus, the sequelae that follow the "direct" effect of cold depend upon the type of tissue involved, and may be superimposed upon each other so that it is impossible to decide, from the examination of the end result, what had been the primary cause and what the consequence.

In order to separate the contribution of the "direct" effect of cold on human skin from its effects upon the vascular and other elements involved and the sequelae that follow, it became necessary to devise a method whereby the latter

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[2] This investigative project is carried out under a grant from the National Research Council of Canada.

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elements would be temporarily excluded. The use of split-thickness skin grafts permits one to subject a portion of human skin, temporarily deprived of the vascular and nervous elements, to the influences of different levels of controlled temperature, for definite periods of time. These observations are carried out under conditions where the interplay of at least some of the various factors involved can be determined and where comparable controls are easily available. The results of these observations will be compared with similar studies carried out on pedicle tubes and flaps (whose vascular supply was intact but in which the nerve supply had been interrupted by transplantation) and with "normal" skin in which the original vascular and nerve elements were intact (2). Thus, it becomes possible by interpolation, to attempt an allocation of the contribution of each of the many factors involved in the pathogenesis of injury by cold.

METHOD OF INVESTIGATION

In order to separate the role of the direct effect of cold on human skin from the sequelae following the effect of cold on vascular elements, free split-thickness skin grafts (0.016 in.) were exposed to the action of different levels of controlled temperatures for definite periods of time.

Free split-thickness skin grafts were selected for the study of the direct effect of cold because they have several features which make them suitable for such investigations:

(a) Relatively uniform thickness of skin can be obtained from similar sites.

(b) They are deprived of blood and nerve supply.

(c) They can be subjected to various temperatures for definite periods of time.

(d) They can be replaced on a suitable bed in the same or different individuals where their behaviour can be studied by means of biopsies and other methods.

(e) Untreated skin grafts can be considered as relatively comparable controls.

The skin grafts were removed under uniform conditions in the operating room using the Padgett-Hood dermatome. The skin grafts were always folded so that the raw surfaces approximated each other in order to reduce drying and were placed in corked glass vials. The vials were carefully sealed with strips of adhesive and appropriately labelled. A few specimens had been removed on one or more occasions for a short period of time and then were restored to the original temperature. Three types of media were used, namely pooled baby plasma, saline impregnated sponges, or air ("dry"). These media were chosen because they had been employed by previous investigators (Webster (9), Strumia (8) and others) thus making our results more comparable to theirs. Moreover, it was possible to study the effect of a wide range of cold temperatures on the different storage media.

The range of temperature studied extended from 39°F. (4°C.) to −108°F. (−78°C.) and the time of exposure varied from a few hours to several months. For practical purposes four levels of temperature were used:

(a) 39°F. to 45°F. (4°C. to 8°C.)

The temperature of the ordinary hospital ward refrigerator.

(b) 32°F. (0°C.)

The temperature of ordinary ice, universally available.

(c) −4°F. (−20°C.)

The temperature of the cooling unit used for storage of plasma.

(d) −108°F. (−78°C.)

The temperature of solid carbon dioxide (dry ice).

Usually the refrigerated skin and "fresh" controls were grafted on surgically "clean" beds, produced by denuding an area by removal of the full thickness of skin or of a contracted scar. All grafts were sutured with interrupted dermalon sutures, covered with xeroform gauze and immobilized by firm pressure with gauze, rubber sponges and cotton waste. Dressings were changed on the third or fourth day and, subsequently, at frequent intervals. Clinical observations were substantiated with photographs and microscopic studies of the biopsies. Histological and cytological study was done entirely on sections obtained from freshly fixed biopsies. All tissues were fixed in 10% formalin and the sections were stained routinely with hematoxylin and eosin, Masson's trichrome stain and Verhoeff's elastic tissue stain.

In order to determine the susceptibility of the refrigerated skin to invasion by bacterial organisms, cultures were taken prior to and just after the removal of the split-thickness skin graft, again at the termination of cooling of the skin grafts, and at frequent intervals subsequent to grafting. Moreover, the behaviour of the refrigerated skin grafts on contaminated or infected granulation tissue resulting from severe burns or from avulsion of skin was compared with that of the "fresh" controls.

EXPERIMENTS AND OBSERVATIONS

It was stated above that the split-thickness skin grafts were cooled at different temperatures and for variable periods of time. Tables I, II and III summarize the pertinent factors in this series of experiments, namely the thickness of skin graft, the temperature and duration of cooling, the medium in which the skin was kept, the nature of the graft bed and the length of survival subsequent to grafting. A total of 103 cold-treated skin grafts were studied—65 were grafted back to the original donor (autografts) and 38 were grafted to some new recipient (homografts).

Table I presents in tabular form the results of refrigeration of free split thickness skin autografts maintained at temperatures above the freezing point (45° to 32° F.) for periods of time varying from 3 to 180 days. The range of temperature between 45°F. and 32°F. (8°C. to 0°C.) appeared to injure the tissues least up to three weeks of exposure: the skin showed minimal reaction, clinically, when grafted to the original donor. The epithelial desquamation was slight and biopsies revealed only moderate infiltration with inflammatory cells in grafts cooled up to 3 weeks at 45°F. to 32°F. More prolonged cooling at these temperatures interferes with the survival of the skin after grafting. Exposure of tissues to lower degrees of cold introduces the influence of another factor—the ice crystal formation—which results in irreversible damage to the protoplasm even after a short exposure. Some grafts exposed to temperature of −4°F. (−20°C.) "took"

well, but no permanent survival in its true sense occurred. Clinical observations alone were misleading and difficult to interpret; the behaviour of tissue frozen for

TABLE I

Effect of refrigeration on free split thickness skin autografts maintained at temperatures above freezing point (45° to 32°F.)

NO.	THICKNESS OF SKIN	TEMPERATURE OF CHILLING (F)(C)	DURATION OF CHILLING	MEDIUM FOR SKIN	NATURE OF THE GRAFT BED	LENGTH OF SURV. OF EPITH.	REFERENCE IN TEXT	REMARKS
	in.		*days*			*days*		
1	0.016	45–39°F.(8–4°C.)	3	S	Denuded skin	*	Protocol #1	
2	"	"	4	S	" "	*	Protocol #1	
3	"	"	8	S	" "	*		
4	"	"	14	D	" "	*	Protocol #3	
5	0.014	"	14	D	" "	*		
6	0.016	"	21	D	" "	*	Protocol #4	
7	"	"	28	D	" "	10	Protocol #7	M, I
8	"	"	29	D	" "	*	Protocol #5	
9	"	"	35	D	" "	16	Protocol #6	
10	"	"	38	D	" "	12	—	
11	"	"	43	D	" "	9	—	
12	"	"	59	D	" "	10	—	
13	"	"	65	D	" "	8	—	
14	"	"	73	S	" "	10	—	M
15	"	"	90	D	" "	14	—	
16	"	"	112	D	" "	9	—	
17	"	"	160	D	" "	8	—	
18	"	"	180	D	" "	7	—	
19	0.014	32°F.(0°C.)	6	D	Gran. T. (Burn)	10	—	I
20	"	"	8	D	Denuded skin	7	—	I
21	"	"	9	D	Gran. T. (Burn)	14	—	I
22	0.016	"	14	D	Denuded skin	*	Protocol #3	
23	"	"	21	D	" "	*	Protocol #4	
24	"	"	21	D	" "	*		
25	"	"	28	D	" "	10	Protocol #7	M, I
26	"	"	29	D	" "	10	Protocol #5	
27	"	"	35	D	" "	14	Protocol #6	
28	"	"	38	D	" "	11	—	
29	"	"	43	D	" "	12	—	
30	"	"	59	D	" "	9	—	M
31	"	"	65	D	" "	10	—	
32	"	"	73	S	" "	10	—	
33	"	"	90	S	" "	16	—	
34	"	"	112	S	" "	10	—	
35	"	"	160	S	" "	12	—	

* Permanent.

S = saline; D = "dry"; M = movement, and I = infection.

a short time was properly understood only when correlated with the histopathological study of the biopsies.

The following protocols are presented because they illustrate the methods of

observation used in all cases of this series and emphasize the importance of correlation of gross clinical observation with the microscopic study of the process

TABLE II

Effect of refrigeration on free split thickness skin autografts maintained at temperatures well below freezing point (−4° to −108°F)

NO	THICKNESS OF SKIN	TEMPERATURE OF FREEZING (F)(C)	DURATION OF FREEZING	MEDIUM FOR SKIN	NATURE OF THE GRAFT BED	LENGTH OF SURV OF EPITH	REFERENCE IN TEXT	REMARKS
	in		days			days		
36	0 016	−4°F (−20°C)	1	D	Denuded skin	*	Protocol #9	
37	"	"	2	D	" "	*	Protocol #9	
38	"	"	4	P	" "	?	Protocol #2	
39	"	"	19	P	Gran T (Burn)	9	—	I
40	"	"	25	P	Denuded skin	11	—	
41	"	"	43	D	" "	11	—	
42	"	"	73	S	" "	10	—	
43	"	"	90	D	" "	12	—	
44	"	"	112	D	" "	11	—	
45	"	"	160	P	" "	12∓	Protocol #8	
46	"	"	160	D	" "	15∓	—	
47	"	"	180	D	" "	11	—	
48	"	"	221	P	" "	18	Protocol #7	
49	"	"	300	P	" "	14	—	
50	"	−108°F (−78°C)	1	D	" "	9	Protocol #9	
51	"	"	2	D	" "	7	Protocol #9	
52	"	"	4	D	" "	11	Protocol #9	
53	"	"	14	D	" "	14	Protocol #3	
54	"	"	21	D	" "	12	Protocol #4	
55	"	"	28	D	" "	11	Protocol #7	I M
56	"	"	29	D	" "	14	Protocol #5	
57	"	"	35	D	" "	12	Protocol #6	
58	"	"	38	D	" "	11	—	
59	"	"	43	D	" "	14	—	
60	"	"	59	D	" "	11	—	M
61	"	"	65	D	" "	12	—	
62	"	"	90	D	" "	20	—	
63	"	"	112	D	" "	7	—	
64	"	"	160	D	" "	10	—	
65	"	"	180	D	" "	9	—	

* Permanent

D = "dry", P = plasma, I = infection, S = saline, and M = movement

Due to lack of space only a few of the protocols are included, but each is representative of a different group of experiments

Protocol No 1 (Exp #2, Table I)
Name R B
Age 19 yrs
Site Abdomen
Thickness 0.016 inches

Conditions of Cooling
Medium Saline gauze
Temperature 45°–39°F (8°–4°C)
Duration 3 days

Patient was admitted for removal of contracting scars on face and hands, the result of a

TABLE III

Effect of cooling and freezing on survival of homografts

NO.	THICKNESS OF SKIN	TEMPERATURE OF COOLING (F)(C)	DURATION OF COOLING	MEDIUM FOR SKIN	NATURE OF THE GRAFT BED	BLOOD GROUP COMPATABILITY	LENGTH OF SURV. OF EPITH.	SURVIVAL OF UNTREAT. HOMOGRAFT	REMARKS
	in.		*days*				*days*	*days*	
1	0.014	45–39 F(8–4°C)	½	S	Denuded skin	No	10	—	
2	"	"	8	D	" "	Yes	6	10	I
3	0.016	"	9	D	" "	Yes	11–13	—	
4	"	"	14	D	" "	No	12	17–21	
5	"	"	23	D	" "	?	9	—	
6	"	"	28	S	" "	No	8–9	—	
7	"	"	35	D	" "	No	10	—	
8	"	"	43	D	" "	Yes	7–9	—	
9	"	"	79	D	" "	?	10	—	
10	"	"	107	D	" "	No	12	—	
11	0.016	32°F(0°C)	8	D	" "	Yes	6	10	I
12	"	"	9	D	" "	Yes	11	—	
13	"	"	14	D	" "	No	10	17–21	
14	"	"	23	D	" "	?	8	—	
15	"	"	28	S	" "	No	10	—	
16	"	"	35	D	" "	No	12	—	
17	"	"	43	D	" "	Yes	9–11	—	
18	"	"	79	D	" "	?	11	—	
19	"	"	107	D	" "	No	12	—	
20	"	−4° to −108°F. (−20° to −78°C)	8	D	" "	Yes	5	10	I
21	"	"	9	D	" "	Yes	11	—	
22	"	"	11	S	" "	Yes	7	—	
23	"	"	14	D	" "	No	11	17–21	
24	"	"	23	D	" "	No	9–10	—	
25	"	"	28	S	" "	Yes	8–10	—	
26	"	"	35	D	" "	No	10–12	—	
27	"	"	43	D	" "	Yes	11	—	
28	0.014	"	65	P	" "	No	12–13	—	
29	0.016	"	79	D	" "	?	12–13	—	
30	"	"	107	D	" "	Yes	14–16	—	
31	"	"	134	S	" "	No	12–16	—	
32	"	"	148	S	" "	Yes	15–17	—	
33	"	"	157	P	" "	No	17	—	
34	"	"	170	D	" "	?	16	—	
35	"	"	183	S	" "	No	15–18	—	
36	"	"	250	D	" "	?	14	—	
37	"	"	290	D	" "	?	13	—	
38	"	"	308	P	" "	No	12–14	—	

S = saline; D = "dry"; I = infection, and P = plasma.

burn one year prior to admission. A split-thickness skin graft was taken from the abdomen with the dermatome 0.016 in. in thickness (Pl. 1, fig. 1) and grafted immediately to the face. A portion of the skin was wrapped in saline impregnated gauze, placed in a sterile glass vial and refrigerated for 3 days at 45°–39°F. (8°–4°C.). At the end of that period of time (fig. 2) the refrigerated skin was grafted to the dorsal aspect of the right hand from which con-

tracting scars had been removed The skin graft was dressed in the usual manner and immobilized with a splint The skin graft took well although it appeared to "lag" behind the control fresh graft for about 3 weeks However, there was no difference in the clinical appearance of the refrigerated skin and the control after one month (Pl 1, figs 3 and 4 give the microscopic appearance of the refrigerated skin graft 6 months after grafting)

Protocol No 2 (Exp #38, Table II)
Name V D
Age 48
Site Abdomen
Thickness 0 016 inches

Conditions of Cooling
Medium Plasma
Temperature −4°F (−20°C)
Duration 4 days

Patient was admitted for removal of old scars sustained as a result of a burn 2 years previously On September 13th a series of skin grafts were applied to his hands a portion of the remaining skin was subjected to −4°F for a period of 4 days On September 17th the frozen skin was thawed rapidly by placing the bottle into water at 99°F , a biopsy was taken and the skin was replaced on to a surgically denuded area on the right wrist produced by the removal of an extensive old scar A fresh autograft was simultaneously grafted over a portion of the thumb as control (Pl 1, fig 5) On September 25th the control had taken 100% The cold treated skin was yellowish in appearance and several blebs filled with yellow fluid were present The patient noticed some sensation of tingling in the area underlying the cold treated graft Biopsies were taken from both grafts On September 30th the "cooled" graft appeared somewhat drier than previously, but yellowish discoloration still persisted over some part of the graft, and some necrotic areas were present The rest of the graft appeared to be well vascularized Biopsies were taken (Pl 1, fig 7) The clinical impression was that there is a "lag" in the "take" of the cold treated skin (Control 100% take) The epithelium over the cold treated graft had been desquamating all along but there was no sign of infection On October 16th the graft appeared fairly well vascularized although the epithelium was extremely thin and there was a generalized erythema of the whole area Photographs and biopsies were taken from the cold treated and from the control skin grafts (Pl 1, figs 8 and 5) Three days later areas of desquamation and scabbing were noted On October 30th several ulcerated pea-sized areas were noted The whole area appeared hyperemic and the epithelium was extremely thin, clinical appearance suggested that of severe chilblain Biopsies and photographs taken The cold treated skin graft remained in about the same condition for the next 3 weeks except that it became less moist, the hyperemia and redness increased The patient stated that itching persisted in the area covered by the cold treated skin graft Biopsies were taken on November 15th (fig 9) and November 27th By this time the cold treated skin looked somewhat less hyperemic The epithelium was always thin and shiny The redness became less conspicuous with time On December 20th the cold treated graft appeared paler still but became fairly indurated, movement at wrist joint was restricted throughout the entire period since the first grafting Biopsies and photographs taken (Pl 1, figs 6, 10, 11) The induration noted before became more conspicuous, the patient stated that he occasionally felt sharp tingling in that area Blebs had been forming sporadically in spite of the fact that cold treated graft was always covered with a bland ointment and a dressing The epithelium was extremely thin and the redness was patchy On the 160th day after grafting of the cold-treated skin, its entire remains were removed and a fresh skin graft placed over the area (Pl 1, figs 12, 13) The control graft took well and the patient was able to resume normal activity with his thumb

Protocol No 3 (Exp #4, 22, 53, Tables I and II)
Name L D
Age 25 yrs
Site Thigh
Thickness 0 016 inches

Conditions of Cooling
Medium "Dry"
Temp 45-39°F (8-4°C)—Graft A, fig 30
32°F (0°C)—Graft B, fig 30
−108°F (−78°C)—Graft C, fig 30
Duration 14 days

PLATE 1—Protocol #1, Figs. 1–4
Protocol #2, Figs. 5–13

FIG. 1. Split-thickness skin graft (0.016 in.) which served as control for the refrigerated skin graft shown in fig. 2. Hematoxylin-eosin. Magnification × 40.

FIG. 2. Split-thickness skin graft (0.016 in.) which was exposed to 45–39°F. for 4 days. Biopsy was taken just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 3. Biopsy of the skin graft cold treated for 4 days (see fig. 2) taken 6 months after grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 4. Section is similar to that shown in Fig. 3 except that a different stain was used. Note the collagen fibres (grey), the elastic fibres (black) and the relatively homogeneous fibrous tissue (scar due to burn) of the underlying graft bed. Elastic tissue stain. Magnification × 40.

FIG. 5. Photograph of the cold treated (4 days at −4°F.) skin graft (B) and of the control (A) taken 29 days after grafting and simultaneously with biopsy shown in fig. 8.

FIG. 6. Photograph of the cold treated skin graft (B) and of the control graft (A) taken 96 days after grafting and simultaneously with the biopsies shown in figs. 10 and 11.

FIG. 7. Biopsy of cold treated skin subjected to −4°F. for 4 days taken 13 days after grafting. The epithelium is flattened and the collagenous fibrils are splayed. There is an absence of the original cell elements of the dermis. Clusters of cells are the result of invasion from the host. Hematoxylin-eosin. Magnification × 40.

FIG. 8. Biopsy of the cold treated skin taken 29 days after grafting. Some of the epithelium became detached during sectioning. The collagen bundles are loose and swollen, and are pried apart by the invasion of fibroblasts and newly formed fibrous tissue. Masson's trichrome stain. Magnification × 40.

FIG. 9. Biopsy of the cold treated skin taken 56 days after grafting. The original components of the graft are infiltrated with fibrous connective tissue and invading blood vessels. Hematoxylin-eosin. Magnification × 40.

FIG. 10. Biopsy of the cold treated skin taken 96 days after grafting. The epithelium is flat (typical of scar). Most of the section is made up of fibrous connective tissue. Remains of collagenous and elastic fibres are inconspicuous in hematoxylin-eosin preparations. Elastic tissue stain. Magnification × 40.

FIG. 11. Biopsy of the untreated skin used as control for the cold treated one (fig. 10). The biopsy was obtained 96 days after grafting and shows all the elements of the skin and the typical wavy epidermis. The homogeneous appearance of the underlying graft bed is due to an old burn. Hematoxylin-eosin. Magnification × 40.

FIG. 12. Biopsy of the cold treated skin taken 160 days after grafting. Note the flat epithelium and homogeneous hyaline fibrous tissue which replaced the original portion of the dermis. The graft bed is seen in the lowest margin of this section. Hematoxylin-eosin. Magnification × 20.

FIG. 13. Higher magnification of the section shown in Fig. 12 brings out the details of the hyaline tissue. Magnification × 100.

PLATE 1

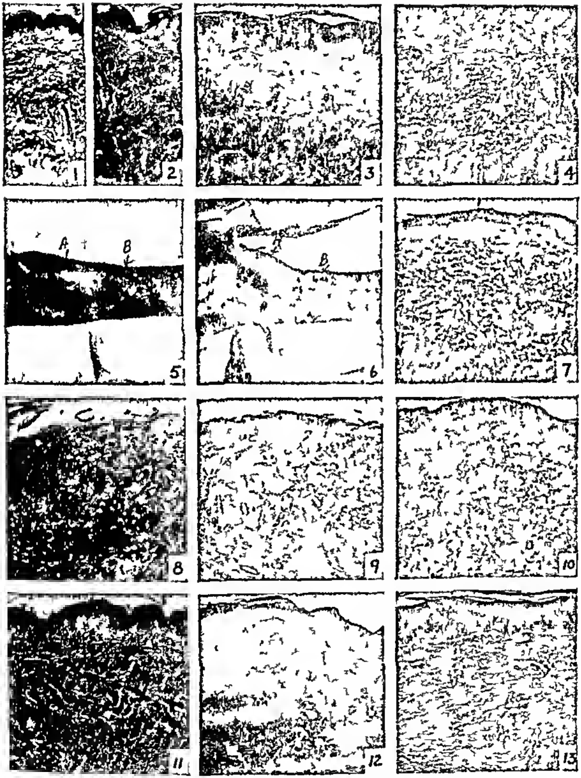


PLATE 3—Protocol #4, figs. 34–53

FIG. 34. Split-thickness skin graft (0.016 in.) shown just before grafting. This skin graft served as control for the cold treated grafts shown in figs. 35, 36 and 37. Hematoxylin-eosin. Magnification × 40.

FIG. 35. Split-thickness skin graft (0.016 in.) subjected to 45–39°F. for 21 days. Biopsy was taken at the end of the period of cooling just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 36. Split-thickness skin graft (0.016 in.) subjected to 32°F. for 21 days. Biopsy was taken at the end of cooling just prior to grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 37. Split-thickness skin graft (0.016 in.) subjected to −108°F. for 21 days. Biopsy was taken at the end of cooling just prior to grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 38. Biopsy of the control skin graft shown in fig. 34 taken 9 days after grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 39. Biopsy of the cold treated skin shown in fig. 35 taken 9 days after grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 40. Biopsy of the cold treated skin shown in fig. 36 taken 9 days after grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 41. Biopsy of the cold treated skin shown in fig. 37 taken 9 days after grafting. Note the lifting of the epithelium. Hematoxylin-eosin. Magnification × 40.

FIG. 42–45. Biopsies of the respective skin grafts shown in figs. 34, 35, 36 and 37 taken 17 days after grafting. Note the marked cellular reaction in fig. 45. Hematoxylin-eosin. Magnification × 40.

FIG. 46–49. Biopsies of the respective skin grafts shown in figs. 34, 35, 36 and 37 taken 33 days after grafting. Note the fibrous replacement of dermal components which is present in figs. 47 and 48 but is particularly marked in fig. 49.

FIG. 50. Photograph of the four skin grafts shown in figs. 38, 39 and 40, 41 taken simultaneously with these biopsies 9 days after grafting.

A—untreated control; B—skin graft was exposed to 45–39°F. for 21 days prior to grafting; C—skin graft was exposed to 32°F. for 21 days prior to grafting; D—skin graft was exposed to −108°F. for 21 days prior to grafting.

FIG. 51. Photograph of the skin grafts shown in fig. 50 taken 14 days after grafting. A, B, C and D as in fig. 50.

FIG. 52. Photograph of skin grafts shown in fig. 50 taken 17 days after grafting and simultaneously with the biopsies shown in figs. 42, 43, 44 and 45. A, B, C and D same as in fig. 50. Note the absence of the epithelium in C and D.

FIG. 53. Photograph of skin grafts shown in fig. 50 taken 29 days after grafting, 4 days prior to the time of biopsies shown in figs. 46, 47, 48 and 49. A, B, C and D same as in fig. 50.

PLATE 3

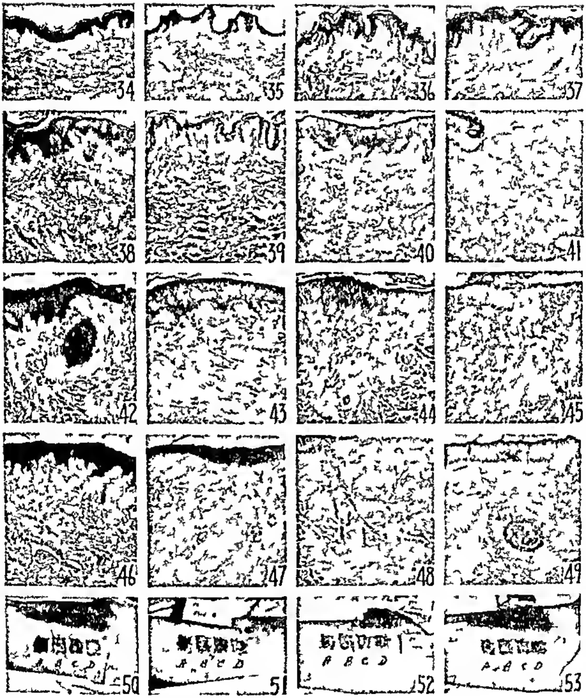


PLATE 4—Protocol #5, figs. 54–73

FIG. 54. Untreated split-thickness skin graft (0.016 in.) which served as control to the cold treated skin grafts shown in figs. 55, 56 and 57. Hematoxylin-eosin. Magnification × 40.

FIG. 55. Split-thickness skin graft (0.016 in.) subjected to 45–39°F. for 29 days. Biopsy was taken at the end of the period of refrigeration just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 56. Split-thickness skin graft (0.016 in.) subjected to 32°F. for 29 days. Biopsy was taken at the end of cooling period just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 57. Split-thickness skin graft (0.016 in.) subjected to −108°F. for 29 days. Biopsy was taken at the end of refrigeration just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 58–61. Biopsies of the respective skin grafts shown in figs. 54, 55, 56 and 57 taken 8 days after grafting. Note the conspicuo [illegible] -mis. Cellular infiltration is most marked in fig. 61. Hematoxy [illegible] × 40.

FIG. 62–65. Biopsies of the respective sk [illegible] 4, 55, 56 and 57 taken 22 days after grafting. The elements of the dermis are being invaded in fig. 63 and 64 and almost entirely replaced by fibrous tissue in fig. 65. Hematoxylin-eosin. Magnification ×40.

FIG. 66–69. Biopsies of the respective skin grafts shown in figs. 54, 55, 56 and 57 taken 34 days after grafting. Note that the dermis has been entirely replaced by fibrous tissue [illegible] Hematoxylin-eosin. Magnification × 40.

[illegible] Photograph of the four skin grafts shown in fig. 54 to 57 taken simultaneously [illegible] -ies shown in figs. 58 to 61, 8 days after grafting.

[illegible] control; B—skin graft was exposed to 45–39°F. for 29 days prior to grafting; [illegible] -aft was exposed to 32°F. for 29 days prior to grafting; D—skin graft was exposed [illegible] °F. for 29 days prior to grafting.

FIG. 71. Photograph of the skin grafts shown in fig. 70 taken 19 days after grafting.

FIG. 72. Photograph of the skin grafts shown in fig. 70 taken 22 days after grafting and simultaneously with the biopsies shown in figs. 62 to 65.

FIG. 73. Photograph of the skin grafts shown in fig. 70 taken 34 days after grafting simultaneously with the biopsies shown in figs. 66 to 69.

PLATE 4

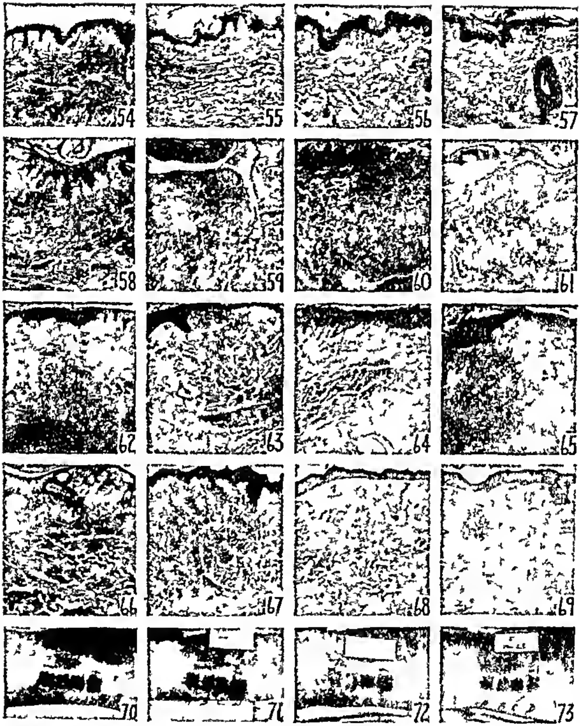


PLATE 5—Protocol #6, figs. 74–93

FIG. 74. Split-thickness skin graft (0.016 in.) subjected to 32°F. for 21 days. Biopsy was taken at the end of cooling period just before grafting. This graft served as another "control" for the three grafts shown in figs. 75, 76 and 77. Hematoxylin-eosin. Magnification × 40.

FIG. 75. Split-thickness skin graft (0.016 in.) subjected to 45–39°F. for 35 days. Biopsy was taken just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 76. Split-thickness skin graft (0.016 in.) subjected to 32°F. for 35 days. Biopsy was taken just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 77. Split-thickness skin graft (0.016 in.) subjected to −108°F. for 35 days. Biopsy was taken at the end of the period of freezing just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 78–81. Biopsies of the cold treated skin grafts shown in figs. 74 to 77 taken 16 days after grafting. Note that epithelium has been lost in all grafts except the one cooled at 32°F. for 21 days (fig. 78). Hematoxylin-eosin. Magnification × 40.

FIG. 82–85. Biopsies of the cold treated skin grafts shown in fig. 74 to 77 taken 26 days after grafting. Note the absence of all recognizable elements of the original dermis in figs. 83, 84 and 85 and the nature of the epithelium which is invading from the host. Hematoxylin-eosin. Magnification × 40.

FIG. 86–89. Biopsies of the cold treated skin grafts shown in figs. 74 to 77 taken 38 days after grafting. Some fibrous replacement is seen even in the graft exposed to 32°F. for 21 days (fig. 86). No recognizable elements of the original skin graft remain in figs. 87, 88 and [illegible]. Hematoxylin-eosin. Magnification × 40.

FIG. 90. Photograph of the four skin grafts shown in figs. 74, 75, 76 and 77 and of the untreated control (A). The photograph was taken 3 days after grafting.

A—untreated control; B—skin graft was subjected to 45–39°F. for 35 days prior to grafting; C—skin graft was subjected to 32°F. for 35 days prior to grafting; D—skin graft was subjected to −108°F. for 35 days prior to grafting; E—skin graft was subjected to 32°F. for 21 days prior to grafting and served as another control.

FIG. 91. Photograph of the skin grafts shown in fig. 90 taken 16 days after grafting, simultaneously with the biopsies shown in figs. 78, 79, 80 and 81.

FIG. 92. Photographs of the skin grafts shown in fig. 90 taken 26 days after grafting, simultaneously with the biopsies shown in figs. 82, 83, 84 and 85.

FIG. 93. Photographs of the skin grafts shown in fig. 90 taken 38 days after grafting, simultaneously with the biopsies shown in figs. 86, 87, 88 and 89. A, B, C, D and E same as in fig. 90.

PLATE 5

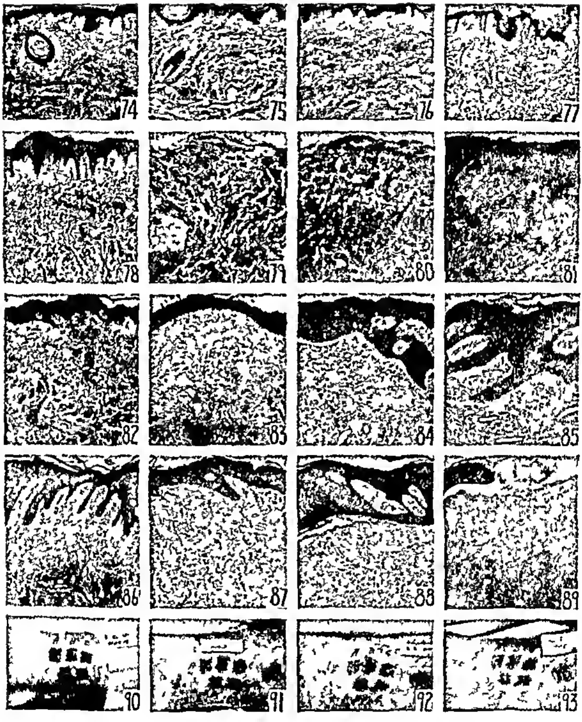


PLATE 6—Protocol #7, Figs. 94–100, 104–105
Protocol #8, Figs. 101–103

FIG. 94. This skin graft (0.016 in.) was subjected to 45–39°F. for 28 days. Biopsy was taken at the end of the period of refrigeration just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 95. Skin graft (0.016 in.) was subjected to 32°F. for 28 days. Biopsy was taken at the end of the refrigeration just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 96. Skin graft (0.016 in.) subjected to −108°F. for 28 days. Biopsy was taken at the end of the period of freezing just before grafting. Hematoxylin-eosin. Magnification × 40.

FIG. 97–99. Biopsies of the cold treated skin grafts shown in figs. 94, 95 and 96 taken 7 days after grafting. Presence of excessive movement and of infection speeded the disintegration of the cold treated grafts. Hematoxylin-eosin. Magnification × 40.

FIG. 100. Biopsy of the skin graft shown in fig. 94 taken 14 days after grafting. Only a few collagenous and elastic fibres remain from the original graft. Hematoxylin-eosin. Magnification × 40.

FIG. 101. This skin graft (0.016 in.) subjected to −4°F. for 160 days prior to grafting. The biopsy was taken 8 days after grafting through the junction of the host margin and the skin graft. The epithelial proliferation is from the host margin. Note the marked inflammatory reaction. Hematoxylin-eosin. Magnification × 60.

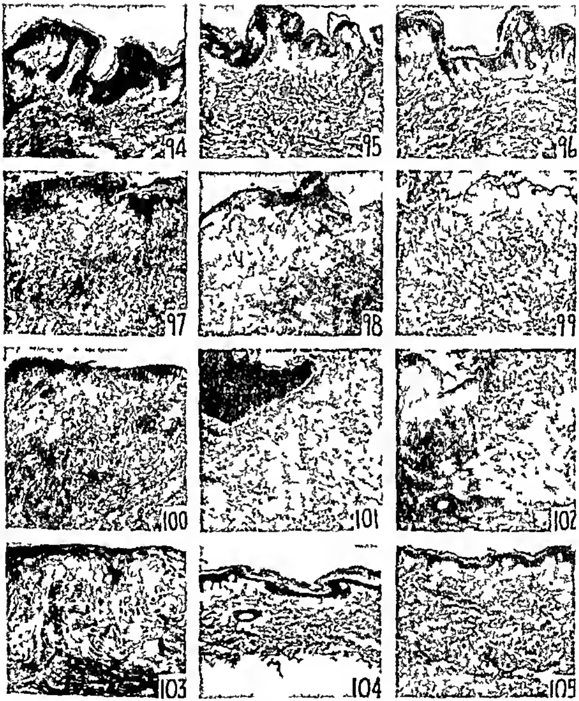
FIG. 102. Same as fig. 101 but from another area. The epithelium of the host is proliferating downwards in an attempt to "isolate" the disintegrating skin graft. Elastic tissue stain. Magnification × 60.

FIG. 103. Biopsy of cold treated skin graft taken 8 days after grafting. The skin graft was subjected to −108°F. for 14 days prior to grafting. The section shows invasion with newly formed blood vessels which reach almost to the surface of the graft. Hematoxylin-eosin. Magnification × 200.

FIG. 104. This skin graft (0.016 in.) was subjected to −4°F. for 221 days prior to grafting. The biopsy was taken at the end of the period of freezing just before grafting. Hematoxylin-eosin. Magnification × 20.

FIG. 105. Biopsy of the skin graft shown in fig. 104 taken 11 days after grafting. Note that all the elements of the skin graft are still intact, but the nuclei are pyknotic, and the cells are swollen. The disintegration of the skin graft is delayed. Hematoxylin-eosin. Magnification × 40.

PLATE 6



Protocol No. 8 (Exp. #45, Table II)
Name: V. D.
Age: 49 yrs.
Site: Thigh
Thickness: 0.016 inches

Conditions of Cooling
Medium: Pooled baby plasma
Temp: −4°F. (−20°C.)
Duration: 160 days

Numerous skin grafts were done on this patient to replace the scars due to an old burn. A piece of split-thickness skin removed with a dermatome from the lateral aspect of the patient's thigh was refrigerated in pooled baby plasma for 160 days. The gross appearance of the skin at the end of that period of time was not remarkable except for the extreme paleness and somewhat gelatinous texture. The refrigerated skin was grafted on to a surgically denuded area on the lateral aspect of the left thigh. It appeared whitish for several days and then turned yellow at the end of one week. Subsequent disintegration was quite rapid (Pl. 6, figs. 101 and 102 show the microscopic appearance of the skin on the 8th day subsequent to grafting). The biopsy was taken at the point of junction of the intact host skin with the refrigerated skin graft. The cellular infiltration is very marked and there is a suggestion that an attempt is being made to isolate the skin graft by the ingrowths of the epithelium from the margins (Pl. 6, fig. 102). All epithelium was gone clinically on the 12th day after grafting.

Protocol No. 9 (Exp. #36, 37, 50, 51, 52, Table II)
Name: M. D.
Age: 23 yrs.
Site: Thigh
Thickness: 0.016 inches

Conditions of Cooling
Medium: "Dry"
Temp: 32°F. (0°C.)—Graft A. fig. 18
−4°F. (−20°C.)—Grafts B and D, fig. 18
−108°F. (−78°C.)—Grafts C and E, fig. 18
Duration: 1, 2 and 4 days

This patient was admitted to our hospital for correction of contraction deformities of his hands resulting from gasoline burns. Split-thickness skin was obtained with a dermatome from his thigh and refrigerated at the above stated temperature for the periods of 1 and 2 days. The skin was then grafted to the denuded areas on the right hand (1 day) and on the left hand (2 days). Skin stored at 32°F. (0°C.) for 4 days served as control (Pl. 2, fig. 18). A piece of skin stored at −108° for 4 days was grafted to the left thigh in an area produced by surgical excision of an old graft. At the end of 1 week the skin stored at −4°F. was moist and with only an occasional bleb. The skin kept at −108°F. presented complete desquamation of epidermis. At the end of 16 days the skin treated at −4°F. appeared fairly well clinically whereas the skin subjected to −108°F. has lost its epidermis (Pl. 2, fig. 18). At the end of 5 weeks after grafting the skin subjected to −4°F. contained many pea-sized areas, reddish in color. The skin subjected to −108°F. for 1 and 2 days prior to grafting had been largely replaced by fibrous tissue although the epithelium appeared to be intact. Biopsies taken at 16 days revealed moderate replacement of the graft stored at −4°F. with fibrous tissue, and a very marked degree of fibrous replacement in the skin subjected to −108°F. for 1 and 2 days. The skin maintained at the latter temperature for 4 days had lost the epidermis entirely by the 11th day (Pl. 2, fig. 14) and the remains of surviving dermis was overgrown by the host epithelium from the margins of the host.

About one-third of the refrigerated split-skin grafts, instead of being replaced on to the original donor were grafted to other individuals (homografts). A total of 38 pieces of skin were cooled at the same temperatures as the autografts but here the experiments entailed the exchange of tissue among 29 different individuals. The time of cooling varied from four hours to 300 days. Clinical observations were carried out in the same manner and the same intervals as with the autografts and in several cases untreated skin homografts were used as controls.

The results of our study are itemized in Table III under the various headings An attempt was made to correlate the blood group compatibility with the length of survival of the refrigerated skin grafts No correlation was found between either the severity of the degree of cooling or the duration of exposure with the length of survival All homografts failed to "take" The rapidity of disintegration varied, but no homograft survived beyond 2 to 3 weeks subsequent to grafting Susceptibility to infection was conspicuous in this series of cases

The detailed description of microscopic findings was omitted from the protocols

TABLE IV

Effect of reduced temperatures on skin grafts (0 016 in)

TEMPERATURE OF EXPOSURE (F) (C)	DURATION OF COOLING	CLINICAL APPEARANCE AFTER GRAFTING	HISTOPATHOLOGY			ULTIMATE FATE OF THE GRAFT
			Epidermis	Dermis	Cellular elements	
	days					
Untreated control	None	Superficial shedding of upper layers of epith Pinkish in color	Swelling and moderate acanthosis of epithelium at first and becoming more compact later	Collagen swollen at first, later fragmented and invaded by blood vessels and some fibroblasts	Lymphocytes and occasional giant cells and eosinophils, later perivascular cuffing plasma cells lymphocytes	Permanent Survival
45-32°F (8-0°C)	3-4	Graft becomes pinkish within a week	Swelling and acanthosis, but staining reaction is paler than control, rete pegs and pigmentation persist	Similar to control but the collagen fibres are coarser and more whirled	Like that of control but more abundant In 6 months only moderate perivascular round cell infiltration	Permanent survival
45-32°F (8-0°C)	7-14	Greyish at first Becomes pink in 8-10 days	Swelling of epith is marked, acanthosis progressively increasing	Collagen swollen, becomes splayed and is infiltrated with fibrous conn tissue	Moderate perivascular infiltration with round cells, later polymorphs, plasma cells eosinophils and occas giant cell	Permanent survival (Microscopically, some degree of fibrous replacement)

TABLE IV—*Continued*

TEMPERATURE OF EXPOSURE (F) (C)	DURATION OF COOLING	CLINICAL APPEARANCE AFTER GRAFTING	HISTOPATHOLOGY			ULTIMATE FATE OF THE GRAFT
			Epidermis	Dermis	Cellular elements	
	days					
45–32°F. (8–0°C.)	21	Whitish in color, some blebbing.	Swelling of epith. and acanthosis followed by flattening. More fragile than control	Collagen swollen, becoming fragmented and infiltrated with conn. tissue and capillaries.	At first marked infiltration at base of graft with lymphocytes, eosinophils, macrophages and giant cells. Later cells scattered throughout graft.	Permanent survival. (Microscopically, moderate fibrous replacement)
45–32°F. (8–0°C.)	28 or more	Pale white at first, may become pink. Usually blebbing within one week.	Epith. is pale staining and flattened. Subsequently desquamates and is lost.	Collagen is swollen; later splaying of fibres and infiltration by fibrous conn. tissue occurs.	Lymphocytes, polymorphs giant cells. Later eosinophils, plasma cells are added. Finally fibroblasts and lymphocytes alone remain.	Complete loss or at best, marked degree of replacement of skin graft by fibrous tissue.
−4°F.	1–2	Whitish and moist, occasional blebbing, eventually dotted with red areas.	Marked edema, swelling and perinuclear vacuolation. Later some cells have ground-glass appearance.	Collagen is swollen and splayed. Staining is good. Later infiltration with fibroblasts.	Dispersed infiltration with lymphocytes as well as some perivascular accumulation.	Partial survival with moderate replacement by fibrous tissue.

TABLE IV—*Continued*

TEMPERATURE OF EXPOSURE (F) (C)	DURATION OF COOLING	CLINICAL APPEARANCE AFTER GRAFTING	HISTOPATHOLOGY			ULTIMATE FATE OF THE GRAFT
			Epidermis	Dermis	Cellular elements	
	days					
−108°F.	1–2	Greyish-white at first, subsequent desquamation of epith. and replacement with scar.	Staining reaction fair to poor, marked swelling, intracellular edema, perinuclear vacuolation.	Collagen is confluent forming homogeneous hyaline masses with pyknotic nuclei.	Occasional polymorphs near epidermis. Fibroblasts, lymphocytes, plasma cells and occasional eosinophils. Capillary infiltration up to epidermis.	Some survival with marked degree of fibrous tissue replacement.
−4 to −108°F. (−20 to −78°C.)	4	Yellowish in color; subsequent blebbing and desquamation of epithelium. Also hyperaemia.	Pale, flattened epith. quite fragile in cutting. Ultimately replaced by flat scar epith.	Collagen is swollen and broken up. Becomes infiltrated with conn. t. cells between fibrils. Finally replaced by hyalinized fibrous scar.	Cellular infiltration begins after a "lag" interval. Graft is dotted with lymphocytes and fibroblasts.	Eventually replaced by hyalian fibrous conn. tissue and "scar" epith. (reaction is more rapid for −108°F.
" "	7–14	Yellowish and blebbing. Epith. lost within 10–14 days.	Epith. is poorly staining and thin. Eventually is completely lost.	Collagen is swollen and fragmented into fibrils. Finally replaced by granulating scar tissue.	Purulent exudate on surface. Fibroblasts, lymphocytes, eosinophils and macrophages are infiltrating from below. Ultimately only foci of small round cells.	Completely lost.

TABLE IV—*Continued*

TEMPERATURE OF EXPOSURE (F) (C)	DURATION OF COOLING	CLINICAL APPEARANCE AFTER GRAFTING	HISTOPATHOLOGY			ULTIMATE FATE OF THE GRAFT
			Epidermus	Dermis	Cellular elements	
	days					
−4 to −108°F (−20 to −78°C.)	21	Whitish at first, later yellow and blebbing. Epith. gone by 12th day.	Epith. is eosinophilic and is entirely lost within one week.	Pale staining glassy collagen dotted by few polys. Ultimately replaced by fibrous conn. tissue.	Polymorphs at surface. At base lymphocytes, polymorphs, eosinophils and giant cells. Same cells persist in foci.	Completely lost.
" "	28 or more	Dead white at first. All epith. lost within two weeks.	Epith. is thin and eosinophilic. Desquamation results in complete loss.	Collagen poorly stained and shredded. Pyknotic nuclei. Splayed fibres invaded by young connective fibrous tissue.	Fibroblasts, lymphocytes and giant cells, later polymorphs appear at surface and marked increase in eosinophils. Subseq. only foci of these cells persist.	Completely lost.

but the essential features were extracted from each case and combined in a chart (Table IV). The headings include the temperature and duration of refrigeration of the skin grafts, the clinical appearance after grafting to the original donor, histopathology, and ultimate fate of the graft. The significance of these findings will be further considered below.

DISCUSSION

Exposure of living tissue to cold temperature produces alterations in the rate of metabolic processes commensurate with the effect on the rate of chemical reaction and enzyme action. The effect of cold on the rate of chemical reaction and on the behaviour of organic substances *in vitro* has been thoroughly studied and is well known. Similar effects take place *in vivo* although they are not as easily demonstrated and sometimes have to be inferred. Moreover, prolonged

chilling at moderately cold temperatures introduces secondary effects which are due to impairment of function of the vascular and nerve elements. Freezing of tissues may bring about a complete destruction of the integrity of cells as a sequelae of the physico-chemical alteration of living matter. A considerable amount of experimental and clinical data has appeared in the literature; we have reviewed this in our previous reports (1 and 2). The intrinsic effect of cold on tissue itself and the effect of cold on the vascular tree may be concurrent, but the sequelae of the latter are more conspicuous and, consequently, have drawn the attention of the investigators. Moreover, it is difficult to separate the intrinsic ("direct") effect of cold on tissue from the subsequent secondary changes due to impairment of blood supply. Greene (3), having studied the effect of frost bite in mice, concluded that in severe cold the blood supply to distant parts is cut off by "silting". He maintained that the subsequent changes were merely reactions of the body to tissue which was rendered "foreign" by the impaired circulation. Similarly, Freedman and his collaborators who studied the effect of cold in rabbits thought that the fundamental lesion due to cold is vascular. They described the reaction as "agglutinative erythrocytic thrombosis" which causes vascular occlusion and thus leads to ischemia and gangrene (4). Other workers who studied the effect of cold in rat tails concluded that cold affects mainly muscles and nerves of rat tails and thought that because the tails are better supplied with blood they are able to effect a greater recovery (5). Many investigators have stressed the role of ischemia in the degenerative changes of the part during and following the cooling period, and attributed only minor significance to the "direct" injury from cold (4, 6, 16).

In order to separate the "direct" action of reduced temperatures on human skin from the secondary effects inherent in the impaired function of the vascular and nervous elements, we subjected split-thickness skin grafts to different temperatures prior to grafting back to the original donor. Untreated skin grafts ordinarily "take" very well and are universally used for repair of raw areas. Usually within 72 to 96 hours after grafting the capillary ingrowths from the host have reached the transplant, and by the 8th day the circulation is established. When a "fresh" skin graft is transplanted to an identical bed simultaneously with one that had been previously chilled or frozen, the effect of the particular temperature on tissue can be observed by the difference in the behaviour of the two transplants. As criteria of evaluation of tissue damage we used clinical appearance and behaviour of the skin grafts, and the cytological studies of changes taking place in the frequent biopsies. Although the cytological appearance may not reflect all the changes of the physical state of the cytoplasm, if the latter are not compatible with survival of the tissue, it will become apparent from the eventual disintegration or from the replacement by fibrous tissue. If the tissue appears normal and remains unaltered for some time, then it can be inferred that whatever injury was inflicted, was compatible with survival.

Four levels of temperature were selected for the present study: two above the freezing level of the human skin (45 to 49°F. and 32°F.) and two below that level (−4°F. and −108°F.). The reason for the selection of these temperature levels

have been pointed out earlier. Ice crystal formation generally begins in intact human skin at about 29°F. (about −2°C.). Although Lewis (7) has demonstrated that it is possible to "supercool" human skin by subjecting it to temperatures considerably lower than 29°F., this is not likely to occur in free skin grafts devoid of blood supply.

Our observations on the "chilling" of free split-thickness (0.016 in.) skin grafts at moderately cold temperatures (45° to 32°F.) were presented in Tables I and II and are summarized in Table IV. Chilling of skin transplants for 3 or 4 days at these temperatures does not materially effect either the take or the subsequent course of the bebaviour of the skin. After two weeks of exposure there is swelling of epithelium and of collagen bundles. The cellular elements increase in number, eosinophils and giant cells become more numerous. Moderate fibrous replacement of the graft results. Three weeks of chilling produces similar changes but a considerable amount of fibrous tissue replacement is noted microscopically. After 4 weeks of chilling there is blebbing and desquamation of epithelium, swelling and splaying of the collagen fibres and a complete replacement with fibrous connective tissue.

The fibrous replacement observed in these cases were noted in other cases where the length of cooling was for a considerably longer period, although at the same temperature. In one or two cases where the piece of skin was small (e.g. 1 sq. cm.) clinical observations alone were misleading because, when the tissue disintegration is rapid, the re-epithelization of the area from the margin may simulate and be interpreted as a "take" and survival of the frozen skin. Careful correlation with biopsies and identification of the various components of the skin graft with special stains permitted correct evaluation of the behaviour of the tissue. "Favorable" results have been reported after prolonged storage at −25°C. (8) and lower temperature (9). We have not observed permanent survival of skin cooled at temperatures lower than 32°F. (0°C.) for more than 2 days.

Lewis has expressed the point of view that the chief factors governing the degree of damage by cold *in vivo* are the temperature and penetration; time after a certain duration he did not consider a material factor (7). Our observations suggest that survival of tissues (skin) chilled detached from the body at moderately cold temperatures (45° to 32°F.) depends on the interaction of time and temperature; the extent and penetration in the case of cooling of skin grafts, is uniform throughout the tissue. The time of storage alone, even without the added insult of moderate or severe cold, is an important factor. Any tissue deprived of its source of nutrition and oxygenation might carry on for some time without immediate death of all cells in it. It was found that guinea pig skin maintains a normal level of respiration at least for 3 days at 39°F. (4°C.) although there is a decrease subsequently (17). But although the length of life of the similar cells in the tissue is about the same, the age of the cells is different and a certain proportion of them will disintegrate each day, undoubtedly at a more rapid rate when deprived of the necessary nutrition. Ultimately, there will come a point at which the number of viable cells in the stored tissue will be too small to effect regeneration even when restored to a suitable graft bed. Other investi-

gators have reported that survival of tissue beyond 3 weeks is unlikely (5). We have not seen survival of the skin grafts beyond 3 weeks of chilling in the range of temperature used (45° to 32°F.), and even up to that time microscopic examination revealed a variable degree of replacement of the graft with fibrous connective tissue. Although refrigeration reduces metabolic requirements and delays the rate of disintegration it does not possess the power of resurrection.

The other two levels of temperatures used in our series of experiments −4°F. (−20°C.) and −108°F. (−78°C.) are well beyond the point of freezing (ice crystal formation). The actual mechanism of damage of tissue by freezing is not known. Breedis (10) enumerated the prevailing theories of the mechanism of causation of damage by freezing. We will mention only two of these:

1. Maximow advances the point of view that ice forms extracellularly and causes death by mechanical compression and injury to the cell.

2. The formation of ice causes dehydration of protoplasm of the cells, produces changes of pH, concentration of toxic substances and some other unknown factors.

Lewis and Love agreed with the contention that ice crystals add further damage to the cell, and demonstrated that super-cooling alone, even well beyond the freezing point of human tissue (−20°C.), did not cause the additional injury that was encountered in actual freezing of tissues (11). Some investigators claim that rapid freezing causes less damage to the tissue because the ice crystals that are formed are small (12). However, Breedis found that slow freezing was superior in his experiments with leukemic cells, and he attributed this to the initial extracellular freezing which concentrated osmotically active materials; partial dehydration of the cell protoplasm thus occurs, rendering it less favorable for ice crystal formation (10). Similarly Briggs and Jund (13) who froze mouse skin for short periods of time in dry ice, report that best results were obtained with slow freezing and rapid thawing.

We found no material difference between the various rates of freezing or thawing, although we have not tried to pour Ringer's solution directly on to the frozen tissue, a method of fast thawing used by Briggs and Jund (13). Skin grafts maintained at −4°F. (−20°C.) for shorter periods (up to 4 days) gave relatively "better survival" of tissue than longer periods of freezing at that temperature or at lower temperatures. However, no survival in its true sense occurred after exposure to temperatures of −4°F. or lower for more than 2 days. The sequence of changes described above (Protocols 2, 3, 4, 5, 6, 7 and 8, Table I, II and IV) shows that the insult of cold and freezing, even after a short time, produces evident damage to the tissue. The extent of alteration of protoplasm is not estimable directly, but it may be inferred from the rapid disintegration that follows transplantation. Even the relatively static collagenous bundles, were fragmented and splayed, and served merely as a scaffolding for the advance of the fibrous tissue. The cellular invasion was not conspicuous. After longer periods of freezing at −4°F. or at −108°F. the disintegration of tissue was more rapid. Whether freezing of the various elements of skin makes them more susceptible to attack by host enzymes and tissue juices is not known. The nature of the inflam-

matory reaction which shows a predominance of polymorphonuclear leukocytes at first, and subsequently an abundance of giant cells, macrophages and eosinophils suggests a more extensive disintegration of tissue than that noted with less severe temperatures (Table IV). Although some investigators have reported that refrigeration of skin grafts enhances the resistance of skin to certain organisms (14) we repeatedly noted the marked vulnerability of such skin grafts even to mild infection (15) (Tables I and II). The epithelial covering of intact skin can withstand a relatively greater trauma than that endured by the underlying tissues. After injury, restitution takes place by regeneration from the intact portion of the epithelium; the underlying dermis does not regenerate but is repaired by fibrous tissue. Moreover, when the epidermis is damaged or destroyed entirely, no regeneration is possible and invasion of the underlying structure by bacterial organisms is inevitable. This is the reason why in our observations the complete disintegration of the epithelium after transplantation of refrigerated skin was taken as the end of survival of the graft, however long the dermis might have persisted beyond that time.

The fundamental unity in the reaction of tissue to freezing and chilling was stressed by Freedman and Kritzler (16) who studied the pathology of high altitude frost bite in man. They maintained that in prolonged moderate cooling (e.g. trench foot) secondary factors begin to exert their influence. They attributed peripheral gangrene to ischemia and considered the necrotizing vascular changes of early lesion to be due directly to the effect of cold. The severe cases of high altitude frost bite that they report showed diffuse sclerosis due to fibrosis and hyalinization which often involved nerves. Among our own cases freezing of skin for 4 days at −4°F. (−20°C.) prior to grafting resulted in marked diffuse sclerosis and hyalinization which became apparent only many weeks after treatment. Protocols 9, Plate I, Figures 12 and 13). It is obvious that these changes were due to the "direct" action of cold on tissue since no vascular or nerve elements were involved in refrigeration of detached skin.

The most marked difference between the chilled and frozen skin grafts is the clinical appearance of the skin which in the latter is yellowish-grey in color and shows marked blebbing. Microscopically, the frozen skin grafts show more extensive degeneration of epithelium, poorer staining reaction and earlier disintegration. The nature of the polymorphonuclear reaction which is more conspicuous for the frozen grafts (Table IV) is not clear. There are several possibilities which may account for it; ice crystal formation inherent in freezing may disrupt the integrity of cells and permit free dissemination of the intercellular contents over the surface of the raw area at the time of grafting. On the other hand, complete disintegration of the epithelium by the process of freezing permits early entrance of bacterial inhabitants of the surface of the skin; these are notorious as a cause of polymorphonuclear reactions. The two factors may be concurrent.

The eosinophils and giant cells are more abundant in the frozen skin grafts. These cells are usually associated with "foreign body" reaction and suggest that the process of freezing renders the protein of the tissue more "foreign", the alteration is not specific for freezing, for prolonged chilling can produce a similar response, though of lesser degree.

The refrigeration of homografts was suggested as a possible means of altering the antigenic properties of the skin which is thought to be responsible for the failure to take when grafted from one donor to a different recipient. Our observations indicate that refrigeration of homografts shortened the length of survival irrespective of the length of exposure or the severity of cold. No attempt is made to evaluate the contribution of the damage by cold to the failure of survival of homografts at this time.

Although the number of cases presented for the different periods of storage does not permit statistical analysis at this time, we believe that the conclusions which we have drawn on the basis of these experiments and a number of subsequent cases not included in this paper, are reasonably valid. In regard to the possibility of storing skin grafts for subsequent use as autografts, the results of our experiments do not indicate that it is practical to refrigerate skin beyond 3 weeks. The low percentage take obtained and the poor quality of the epithelial cover renders any attempt to prolong storage quite impractical. We would recommend maintaining the tissue in dry, sterile, well sealed glass containers. These should be kept in a thermos container filled with ice which in turn is kept in an ordinary refrigerator; thus a constant temperature is maintained (32°F.) and accidents due to alteration of temperature or sudden failure of the refrigeration are thus avoided.

SUMMARY AND CONCLUSION

In order to separate the role of the "direct" effect of cold on human skin from the sequelae following the effect of cold on vascular elements, free split-thickness skin grafts (0.016 in.) were exposed to the action of different levels of controlled temperatures for definite periods of time. At the end of the period of cooling such grafts were transplanted along with suitable controls to the original donor or to a different recipient and their behaviour was followed clinically and microscopically by means of biopsies.

Pooled baby plasma, saline impregnated gauze and air were used as the media for the skin grafts. Four levels of temperature were used: two above the freezing point (45° to 39°F. and 32°F.) and two below the freezing point (−4°F. and −108°F.). The duration of cooling varied from a few hours to ten months.

The results of observation are presented in tabular form and several protocols are included in order to illustrate the methods used in this study. The microscopic observation based on the study of the biopsies are correlated with the clinical findings and are presented in the form of a chart.

A total of 65 autografts and 38 homografts have been subjected to the influence of the different temperatures before transplantation. The range of temperature between 45° and 32°F. (8° to 0°F.) did not materially effect the survival of skin grafts up to 3 weeks of cooling: the desquamation was slight and fibrous tissue replacement only moderate. More prolonged cooling at these temperatures interfered with survival of the skin after grafting.

Exposure of skin grafts to −4°F. (−20°C.) and −108°F. (−78°C.) brings about ice crystal formation which is not compatible with survival. Even after short exposure fibrous tissue replacement results. Longer periods of freezing

result in complete disintegration of the skin graft at such a rapid rate that replacement by host tissue is inadequate.

Clinical observations alone were difficult to interpret and were properly understood only when correlated with the microscopic study of frequent biopsies. Photographs and photomicrographs illustrating the sequence of events are presented for several of the cases studied.

Refrigeration of homografts shortened the length of survival of the skin grafts following transplantation irrespective of the length of exposure or the severity of cold.

The difference between chilling and freezing of skin grafts is most apparent in the clinical and microscopic reaction of the epithelium, and in the character and volume of the inflammatory reaction. The possible mechanisms of injury by chilling and freezing are discussed.

The practical application of the results of investigation is that split-thickness skin grafts can be maintained at 32°F. (0°C.) up to about 3 weeks, and still "take" successfully when transplanted as autografts. Beyond that time the amount of graft which survives is not sufficiently high to render this procedure useful from either the cosmetic or functional view point.

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STUDY OF THE VITALITY OF TISSUE TRANSPLANTS BY MEANS OF RADIOACTIVE PHOSPHORUS: PRELIMINARY REPORT

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The development of the circulation and vitality of pedicle, cartilage and bone grafts have always been of interest to the plastic surgeon, and many techniques and methods have been employed for their study.

There has been considerable controversy in the past on the subject of vitality of bone grafts immediately following their transplantation. It has been stated in the literature that all bone grafts become areas of aseptic necrosis (1) soon after their transplantation, followed by the deposition of new bone laid down in the area after varying lengths of time (2, 3). Another theory states that bone becomes vascularized from the periosteum (4, 5). These conclusions and theories were reached by evidence based on clinical and radiographic findings.

During the war, cancellous bone grafts from the iliac crest became very popular for the reconstruction of facial contours and replacement of actual loss of the mandible to restore function of that bone. Clinical, microscopic, and x-ray findings showed that cancellous bone which had been decorticated before implantation, developed a cortical layer within eight weeks (6). This is fairly good, but not positive proof that these grafts survive from the time that they are transplanted.

Since the introduction of radioactive isotopes for use as tracer elements, these materials have been employed to study many biological processes including intermediate metabolism, excretion of various metabolites, and circulation of various compounds and elements in intact tissues.

In the following work, radiophosphorus (P^{32}) has been used to study the rate at which vital cartilage and iliac bone transplants develop their own tissue fluid exchange, and blood supply in animals.

In order to measure the ratios of assimilated phosphorus, approximately 100 microcuries of dibasic sodium phosphate (P^{32}) was injected intravenously to dogs of approximately twelve kilograms in weight. The P^{32} was not carrier free and had approximately one microgram of inert dibasic sodium phosphate per microcurie of radioactive material.

Selection of P^{32} was governed by two reasons: one, this isotope emits a beta particle of 1.69 million electron volts peak energy, thus being easily adaptable to both assay methods employing Geiger counters and to those employing the radioautograph technique. Second, while a large percentage of the radiophos-

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phorus will be deposited in bone (approximately 20%), a similar amount will also be deposited in the soft tissues (approximately 30%), thus facilitating the exchange of the phosphorus to the transplanted bone via the circulatory system. By this method the intensity of deposit should be in direct proportion to the blood supply to that area (7).

Radioactive strontium (Sr^{89}) could also be used, but since the amount deposited in the soft tissues would be negligible, the exchange reaction would be much less. However, because of its strong affinity for bone, the use of strontium is anticipated for our later studies as it is particularly adaptable for radioautographic recording of calcification.

In the Geiger counter method of comparative assimilation, bone samples of approximately 0.1 to 0.4 grams were removed and ashed, the residue taken up in nitric acid and the resulting solution evaporated in a flat porcelain crucible (8). This standardizes the physical conditions of the bone samples, equalizes the self absorption of the beta particle, and permits a direct estimate of the amount of

FIG. 1. Radioautograph of vital (left) and devital bone graft, showing homogeneous distribution of P^{32} in the vital graft as compared to the peripheral distribution in the devital graft.

P^{32} absorbed per gram of bone. Readings recorded here are based on this method and will have the units of counts recorded per minute (by Geiger tube) for one gram of bone (c/m/g).

The method of obtaining radioautographs employed the standard system of directly exposing various removed samples to photographic film. Super-imposing the sample over the film for several hours has resulted in the heaviest exposure for the section containing the largest quantity of radioactive material. (See fig. 1.) This shows conclusively both the assimilation of P^{32} by various bone components and the variation in amount of assimilation by different types of grafts. The results of these studies have been divided into three sections.

SECTION I

In this first section, studies have been made to observe the relative assimilation of phosphorus by vital transplanted bone and cartilage as compared to the normal. Iliac bone, both cancellous and cortical, with the periosteum removed, and costal cartilage without perichondrium was obtained from the dog and cut into uniform pieces. These were buried subcutaneously in the ventral surface of the same animal. Immediately following transplantation of the bone, the P^{32} was administered and twenty-four hours later the first piece of transplanted bone and cartilage and controls were removed for assay.

In the first twenty-four hours following transplantation, it was found that transplanted iliac bone assimilates P^{32} at approximately 60% of the amount taken up by the same weight of normal control iliac bone. In the same manner, costal cartilage assimilates P^{32} at approximately 40% of normal in the first twenty-four hours.

Similar samples of bone and cartilage were removed every twenty-four hours for four days and showed that they continue to absorb P^{32} not only at the same rate, but tend to overcome the 40% deficiency as shown in the following table and graph. (See fig. 2.)

NO DAYS AFTER TRANSPLANT	P^{32} ASSIMILATION RATIOS OF TRANSPLANTED BONE TO NORMAL BONE	P^{32} ASSIMILATION RATIOS OF TRANSPLANTED CARTILAGE TO NORMAL CARTILAGE
	per cent	*per cent*
1	57.4	36.9
2	70.8	65.8
3	46.1	29.7
4	47.6	64.4
10	92.9	88.0

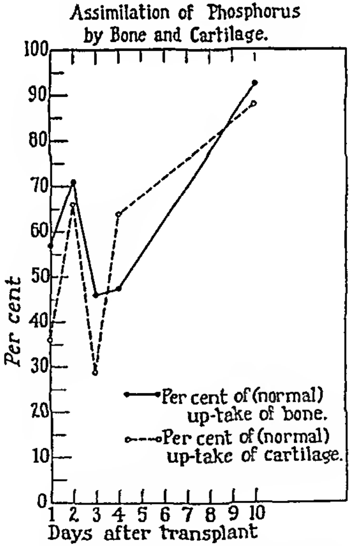

FIG. 2. Assimilation of Phosphorus by Bone and Cartilage

SECTION II

Having observed the relative deposit of phosphorus in vital transplants, this second section had been undertaken to study the assimilation of phosphorus by devital bone. In this study three specimens of bone which were devitalized by boiling and then implanted and assayed, showed approximately 7% uptake of P^{32} as compared with normal bone. This was probably due to adsorption and is considered negligible as compared to vital and control bone uptake. The accompanying radioautographs show P^{32} to be deposited peripherally in the devital bone as compared with homogeneous distribution seen in the control bone specimen. A single exception showing a high concentration of P^{32} has been observed, but it is uncertain whether this is due to experimental error of laboratory contamination or the possibility of bone recovery.

SECTION III

The object of this section has been to study the effects of refrigeration on the vitality of bone grafts (9). The same technique was used as in the previous experiments except that the bone was stored in a refrigerator at −2 degrees Centigrade for varying periods.

Five samples were removed at approximately one week apart and their assimilation compared to normal bone over this period.

These data are insufficient for tabulation at the present time but comparison with similar figures for vital and devital grafts suggests that assimilation is depressed for at least a period of one week after transplanting. It appears that refrigerated bone is partially devital or dormant bone, but may recover its vitality the longer it is left in the animal. Studies are now in progress to establish this conclusively.

CONCLUSION

While the amount of statistical data is insufficient at the present time to justify definite conclusions, there are many trends which are sufficiently indicative to warrant further investigation.

Probably the most fundamental of these indications is the existence of bone as a vital graft, forming its own blood supply and integrating itself as a vital part of the system from the time it is transplanted. This is shown by the immediate assimilation of P^{32} by the vital grafts as compared to low uptake by the devital transplants. Since the intensity is a function of the blood supply, the immediate recovery has been definitely observed.

The second indication from which practical applications may be drawn is the observation that refrigeration may not depress the recovery of transplanted bone beyond a short initial stage.

We feel that these early studies show this and similar methods to be useful in the study of the vitality of bone and other transplants including pedicles and grafts. It may also be of interest in the healing of intact tissues.

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PHAGEDENIC ULCER OF THE PENIS WITH PLASTIC REPAIR*

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AND

J. HAROLD KAY, M.D.

Phagedenic ulceration of the penis due to non-venereal infections is a rare condition but when encountered it presents problems of major magnitudes. Immediately all of one's efforts should be focussed on those procedures that will combat and limit the destructive processes and this therapy should be carried out with dispatch. At the same instant one must have in mind those reparative steps that will be necessary to return the involved part to its physiological norm when the infection has been controlled.

Phagedenic infections are noted for their rapidity of spread and for their marked destruction of involved tissue. Control of the infection is paramount to preserve life and to prevent and limit tissue destruction. We feel limitation of this virulent infection is best accomplished by the early and wide use of the cautery, local applications of penicillin to the involved area and penicillin intramuscularly (300,000 units every 24 hours). The infected area should be cauterized one inch distal to the gangrenous ulcer and all of the skin and involved subcutaneous tissue should be removed. The base of the ulcer should be thoroughly cauterized, as is the periphery, but where the penis is involved one has to be extremely careful to spare as much as possible, from a functional standpoint, the all important corpa cavernosum and urethra.

In the case under discussion although the spread of the infection was rapid, a definite limitation of the gangrenous extension was noted in a matter of hours. Twelve hours after entry into the hospital a line of demarkation of dry gangrene was established and a complete cast of the skin and subcutaneous tissue of the penis was surgically removed. This left a denuded area completely encircling the penis extending from one-half inch below the penile abdominal junction to one-half inch proximal to the corona. This wound was treated with continuous penicillin soaks along with general supportive measures for a period of eight weeks before the plastic service was consulted. By this time abdominal induration and redness had subsided, penile edema had diminished and the ulcer bed was clean. The reparative processes were under way as evidenced by the peripheral epithelization of the ulcer bed.

CASE REPORT

Male, 18 years, single, Indian.

Present Illness: This patient was perfectly well until twelve days before entry into the hospital, at which time he noticed a small bluish area on the under side of the penis. This became larger and he went to a doctor who treated this with local applications of sulfathiazole ointment and sulfathiazole by mouth. The redness continued to spread over the shaft of the penis to the lower portion of the abdomen almost to the umbilicus. The patient

* Read before the American Association of Plastic Surgeons, Annual Meeting, 1947, Memphis, Tenn.

denies any sex contact or trauma of any type prior to the onset of the present illness. He had been confined for the previous 10 weeks to Boot Camp at Great Lakes without liberty.

Past History:

Operations	aegative
Accidents	negative
Habits	normal
Illaess	normal childhood

Family History: Essentially negative.

Systems: Normal.

Physical Examination: Well developed and nourished Indian male in no great distress. Temperature, 98.6, pulse, 80; respiration, 20.

Eyes, Ears, Nose: Negative.

Skin: Negative (see Genitalia).

Heart and Lungs: Negative.

Fig. 1. Phagedenic ulceration of the penis. Demarcation of skin and subcutaneous gangrene

Abdomen: Lower end of the abdomen was indurated and reddened. No masses palpable.

Extremities: Normal.

Genitalia: The penis and scrotum were markedly edematous. There was a gangrenous
The gangrenous margins are clearly defined, irregular and starting to separate.
area on the penis extending from the corona to ½" distal to the penile abdominal junction.

Treatment: 1. Culture and smear from the involved area. 2. Blood Kahn and dark field examination were negative. 3. Continuous penicillin soaks to the penis plus 12,500 units of penicillin intramuscularly every three hours

Twelve hours after admission a complete mold of the penis was surgically removed and this left an ulcer from about ½ inch from the lower penile abdominal junction to the glans penis. The ulcer base was reddened and clean appearing. A suprapubic cystotomy was performed under 100 mgm. novocaine as urethral involvement was imminent.

In spite of the existing infection, to speed healing and prevent functional loss of the part it was necessary to cover the defect as quickly as possible with normal

tissue. Split skin grafts have been used and have given excellent results in cases of clean avulsion of the penile skin and also in some cases of the superficial ulcers.

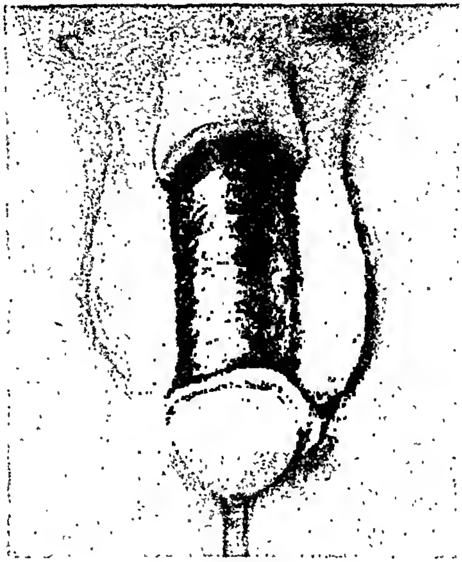

Fig. 2. Gangrenous Area and Resulting Scar Removed

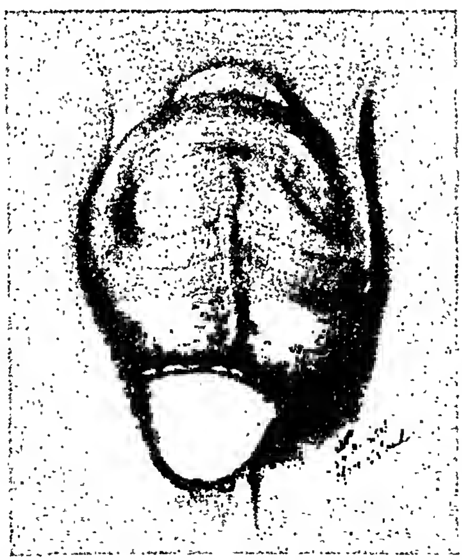

Fig. 3. First Stage of Plastic Procedure with Penis Buried in Thin Anterior Covering of Scrotum

In this particular instance, however, due to the type and severity of the infection plus the extent and depth of the ulcer a pedicle type of graft was indicated. This

flap would have the advantage of not only supplying a skin and subcutaneous covering, but also the additional advantage of its own independent blood supply.

Fig 4 Second stage of penile plastic repair showing scrotal flaps sutured under penis and scrotum reconstructed

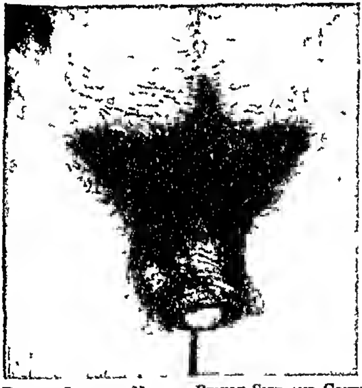

Fig 5 End Result Showing Normal Penile Size and Covering Note Lack of Hair on Penile Skin

At the first plastic procedure all of the existing scar tissue adjacent to the ulcer as well as the scar tissue of the ulcer bed was removed Although this procedure

materially increased the existing defect, it returned all the parts to their normal position. It gave the involved area a better surgical base and made the penis longer and more pliable. An incision was then made in the superior central part of the scrotum at the base of the penis. A very thin layer of skin and subcutaneous tissue was elevated by dissection on the central hairless portion of the scrotum. An appropriate counter opening was made at the distal part of the scrotum. The penis was brought through this skin tunnel and the epithelial edges were sutured into place both at the penile base and just behind the corona. Healing occurred by first intention, so that in three weeks it was possible to proceed with the second phase of the reparative process. Using the scrotal skin covering of the penis as a base, adjoining measured flaps were created from the scrotum and these were brought around the penis and sutured in midline posteriorly. The flaps came together at the penile base in the form of a T completely covering the penile shaft. The scrotal defects were easily closed without tension.

At the present time the penile edema has subsided, function is normal and a gradual return of sensation is taking place in the covering flaps. The return of sensation in the transplanted skin will be complete in from four to six months after the last surgical procedure.

DERMOID CYSTS OF THE NOSE

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Many case reports on this subject have been recorded in the literature since 1933 The rhinologists primarily have been confronted with the final treatment and the majority of the writings have been in the periodicals of Otolaryngology In reviewing these cases, it was seen that frequently dermoid cysts involving the nose were either not recognized or were not properly handled until placed in the hands of one who recognized this type of tumor, its morphological variations, and the embryology

In 1937 New and Erich reviewed 1495 dermoid cysts Of this number, 103 involved the head and neck, of which 13, or 12 6% were in the region of the nose Specifically located, 9 were over the region of the nasal bones, 2 at the base of the columella, 1 at the tip, and 1 in the septum Roughly 50 cases involving the nose are on record, the big majority of which have appeared in the last four years This is not a rare tumor

The Plastic Surgeon is concerned with dermoids of the nose for several reasons The tumors themselves are frequently deforming, both to the skin and nasal contour They may disturb the relationship of the nasal bones by displacement Following the removal of the larger cysts with extension, there may be considerable deformity requiring rhinoplasty or the use of implants

As to origin, the statement that dermoids of the nose merely represent the inclusion of skin remnants in the median lines of closure, is not sufficiently explanatory Brunner and Donnelly very adequately describe the most feasible theory of their formation using cross sections of the nasal processes in the newborn as a basis for their findings They state, "In the newborn the anterior wall of the nose consists of one single cartilaginous plate which is covered on the outside by connective tissue and skin The connective tissue originates from the dura During the intramembranous formation of the nasal bones, the connective tissues and the skin become separated and between the cartilaginous wall of the nose and the nasal bones there is a prenasal space filled with connective tissue of dural origin Soon after birth the cartilage of the nasal capsule disappears while the cartilages below the nasal bones persist and form the upper and lower lateral cartilages When the nasal bones are formed, the displaced parts of ectoderm are situated in the prenasal space, viz , between the cartilaginous nasal wall and the nasal bones The displaced parts of ectoderm advance eventually to the formation of dermoids which may or may not remain in connection with the skin " If contact with the skin remains, a fistula running between the nasal bones is formed If the dermoid is free of the skin, even so it may become infected and a fistula develop when the infection breaks through the nasal bones and skin In dissecting out dermoids of the nose one must be aware of the

deep-seated origin and be certain to remove possible deep ramifications. Furthermore, their early removal should be carried out because of their potential growth and displacement of the bony and cartilaginous nasal frame.

Dermoids of the nose are seen most frequently in infants and young children. In most cases a swelling over the nose or the presence of a skin pit in the midline of the nose is noted shortly after birth. Little attention is given these unless they are large, grow rapidly, or become infected. They may vary in size from that of a small pea to a walnut or larger. The skin pit is usually seen over the nasal bones or upper cartilages, whereas the cyst itself may be anywhere from the frontal region to the tip of the nose. Several have been reported inside the nose. Most frequently they lie at the level of the nasal bones. Because of the mild deformity caused by the smaller cysts, these patients are usually not seen by a doctor unless an abscess has formed. There may be persistent drainage from the sinus opening. The larger cysts are deforming enough in themselves to necessitate removal. They may previously have been incised, cauterized or curetted, only to recur or drain continually.

On examination, there is usually a midline pit or fistula and the mass appears superficial. The overlying skin is attached around the fistula or may be bound firmly to the mass, if infection has been present. They give the impression of being free from attachment to the underlying bone or cartilages; however, usually they are connected by a stalk. The cyst itself may extend deep into the septum, beneath the cartilages or nasal bones. Frequently there is a definite separation of the bones or cartilages in the midline. It must be remembered that their origin is deeper than just below the skin.

We are presenting an unusual case where the cyst appeared as a swelling over the bridge of the nose with a central sinus opening. This dermoid was found to extend under the periosteum of the glabella as a narrow channel and open into a larger frontal extension over the frontal sinuses, still beneath the periosteum. This had eroded the outer table of bone in this area. This particular dermoid had a stalk extending downward between the nasal bones.

X-ray may show a separation of the nasal bones or a distortion, giving a clue as to the depth of the stalk or penetration of the cyst. When an external fistula is present, instillation of lipiodol outlines the extent of the fistula and cyst.

In the differential diagnosis one must consider; (a) meningocele and encephalocele, (b) sebaceous cyst, and (c) inclusion cyst (usually old trauma). Meningocele is translucent when light is passed through, whereas dermoid is opaque. They are usually of larger size, soft, very fluctuant, and drain clear cerebrospinal fluid when there is a skin opening. Compression of the jugular veins may cause the mass to become tense by increase of pressure within the sac. In a distended condition there may be visible pulsation. Ordinarily, a meningocele will be more fluctuant and not show the midline skin pit seen with dermoids. Encephalocele is rare. They are usually not visible in this region, but are of the basal type, projecting into the nasal cavity through the cribiform plate of the ethmoid bone. Sebaceous cysts, unless previously ruptured to the outside are more discrete and freely movable under the skin. An inclusion cyst presents a history of trauma with inbedded skin.

The pathology is simple. Dermoid cysts have a lining of stratified squamous epithelium with prominent keratinization. The central contents consists of desquamated, cheesy material, usually with the presence of hair. Frequently the cyst has become infected and contains granulation tissue and considerable surrounding fibrosis.

Treatment consists of complete excision. Frequently they have been previously incised, cauterized or curetted and recurred. X-ray of the nasal bones and lipiodol instillation of the external fistula should be carried out to be certain of the depth and location of the fistula and cyst. The skin pit should be excised en toto with the mass. The cyst is best approached directly over the main body with

FIG. 1

[illegible] A seven months old male child. Note central skin [illegible] view shows the diffuse swelling over the bridge and [illegible]

adequate exposure to be certain of complete excision. Rhinoplasty is best done secondarily because of possible chronic infection in the depths of the excised area.

*Case 1.** A seven months old white male child. At birth a soft, midline bulge was noted over the bridge of the nose. Just above the main body of the mass was a central sinus opening which had been draining whitish, turbid fluid. The mass enlarged gradually over the glabellar region and six weeks before entry appeared to enlarge rapidly over the frontal sinuses and right brow. The central pit was at the level of the inner canthus of the eye. The diagnosis of meningocele was made previously by a neurosurgeon. This was excised through a vertical midline incision which included the central pit in an ellipse of skin. A small cyst was encountered under the subcutaneous fat. This was attached to the periosteum of the upper part of the nasal bones. The pedicle disappeared beneath the periosteum

* Cases of Dr. Robert McNaught, Ear, Nose and Throat Dept., Stanford University School of Medicine.

Fig. 2(A)
Case 2. Pre-operative photographs. An eleven months old female child. The central skin pit may be seen over the inferior border of the nasal bones. Lateral view shows a hump-like swelling.

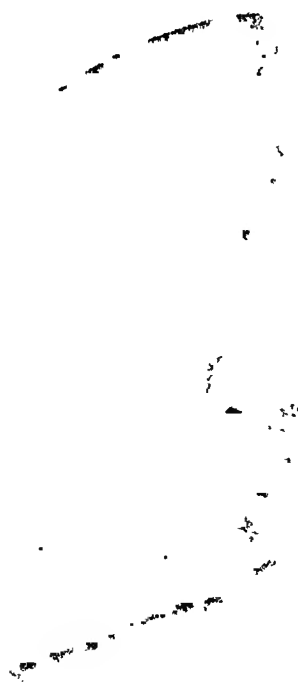

Fig. 2(B)
Profile x-rays showing a rounded area of rarefaction in the nasal bones. The bones are thickened around the edges of the cyst. At operation it was seen that the septal and upper lateral cartilages were actually depressed by the body of the cyst.

at this point The skin excision was lengthened upward and the cyst was then found to extend over the frontal sinuses the size of a silver dollar beneath the periosteum and outlined by an irregular ridge of frontal bone The outer table of bone over this area was eroded away The nasal and frontal components were contiguous through the narrow channel which ran upward beneath the periosteum The contents of the cyst were milky and freely fluid

Fig 3(A)

Histological examination Two epithelial lined sacs connected by a narrow tract Contents consisted of desquamated, keratinized material with granulation tissue and fibrosis in one area

Case 2 * A eleven months old white female child A swelling and central midline pit was noted over the bridge of the nose since birth This had enlarged moderately but did not drain The nose was deformed by a prominent hump and widening in the region of the nasal bones A narrow ellipse of skin including the midline pit was outlined by vertical incisions about 3 cms long A thin walled cyst which had depressed the upper lateral and septal cartilages was exposed This had an upward prolongation attached to the periosteum on the surface of the nasal bones

AURICULO-MASTOID TUBE PEDICLE FOR OTOPLASTY

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The complexity in the topographical anatomy of the auricle overtaxes the ingenuity of the plastic surgeon to attain perfection in the restoration of the auricular deformities. The extremely thin yellow elastic fibrocartilaginous support of the normal auricle, covered by a very thin and extremely vascular integument, both folded in multiple concavo-convex and convexo-concave topography, and both anchored at an approximate thirty degree auriculo-cranial angle to the temporal bone by extrinsic ligaments and muscles, call for the solution of the following three problems in the restoration of a partial or a total loss of the auricle.

First, the restoration of the cartilaginous support either by autogenous or homogenous cartilage. For this, the ingenuity or the esthetic appreciation of the operator alone will determine the duplication of a near normal configuration of the cartilaginous frame.

The second problem calls for supplying soft tissue coverage for the supporting cartilaginous frame, either by the use of local tissues, or tissues from the immediate or distant surrounding areas in form of flaps or tube pedicles.

The third problem calls for the immobilization of the reconstructed auricle to the side of the head at the correct angle.

Each step of the operative procedure will dictate the eventual appearance of the reconstructed auricle. A large, thick and poorly carved cartilaginous support will not only result in a bulky and poorly differentiated auricle, but will also add to the weight of the same, which in itself will create or complicate the problem of a stationary immobilization of the auricle. An improperly immobilized auricle will move or flap with each walking step, which is an extremely conscious and annoying experience to the patient. The weight of the auricle is increased with the thickness of the flap and the size and the weight of the tube pedicle, when such are used. A split thickness skin graft of a post auricular flap with a deficient cartilaginous support, will tend to contract later on, and distort the final appearance of what may have been an extremely satisfactory auricular reconstruction as viewed on the operating table.

The purpose of the case here presented is to emphasize the necessity for an occasional departure from the usual methods of reconstruction of a partial loss of the auricle, which departure is usually dictated by some anatomical factors of the individual case. In this case, the patient was a subject of marked hypertrichosis, which forced the operator to depart from the usual practice of formation of a supra-clavicular or post auricular tube pedicle for the restoration of the lost helix, and in this case forced him to utilize the skin from the medial surface of the auricle and also the skin over the mastoid area. The anatomical nomenclature

Presented at the Surgical Staff Meeting, William Beaumont General Hospital Plastic Surgery Center, El Paso, Texas, 20 September 1947.

"auriculo-mastoid tube pedicle" localizes the donor site of this type of tube pedicle.

CASE REPORT

This 27-year old white male patient lost the middle one-third of the left auricle including the posterior one-half of the concha following a human bite on 8 December 1946. The defect measured 58 mm. long and 17 mm. wide (figs 1 and 13), the margins of which were healed at the time of his transfer to William Beaumont General Hospital Plastic Surgery Center—18 January 1947. The patient was a subject of marked hypertrichosis, involving not only the body but also the supraclavicular and inferior auriculo-cervical area. This marked hypertrichosis robbed the patient from the usual donor sites for the formation of a

Fig. 1. Auricular Defect due to Human bite

tube pedicle to be used for the restoration of the helix. Otherwise the Physical Examination was essentially negative. Repeated WBC averaged 9,950 with a normal differential distribution and 15.6 gm % Hb.

OPERATIVE PROCEDURES

The reconstruction of the auricle required eight operative steps, which were completed in five months.

The first step, done on 6 February 1947, consisted of making an auriculo-mastoid tube pedicle. The scar along the margin of the defect was excised. The denuded edges were projected over the hair-free skin of the mastoid area and marked with methylene blue, outlining the anterior margin of a post auricular flap to be later raised and sutured to the denuded margins of the auricular defect. The width of the skin area anteriorly of the methylene blue line, up to the au-

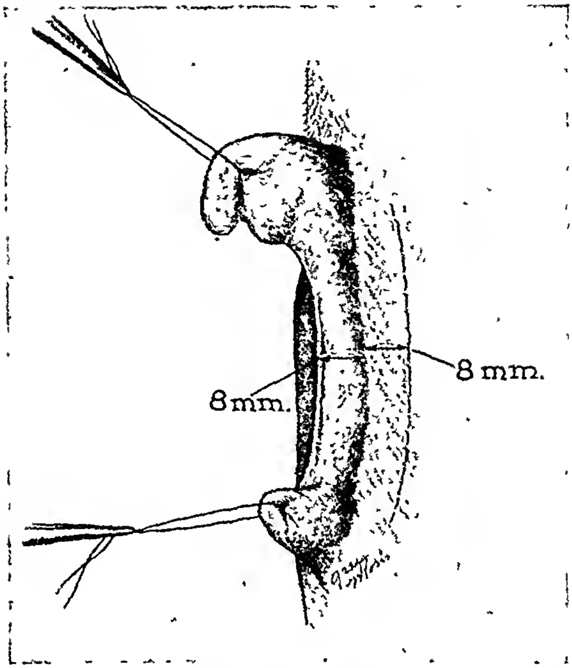

FIG. 2. POSTERIOR VIEW OF THE DEFECT AND LOCATION OF THE AURICULO-MASTOID TUBE PEDICLE

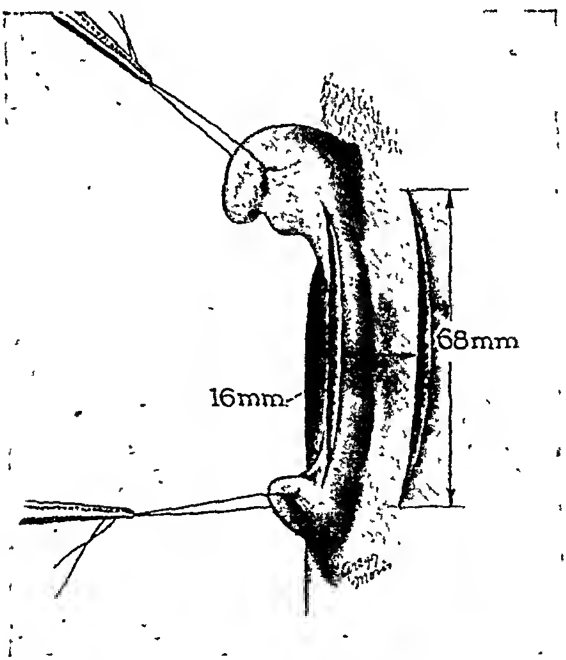

FIG. 3. INCISIONS PRIOR TO ROLLING OF THE TUBE PEDICLE

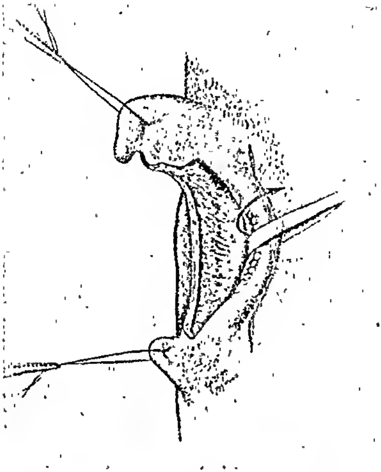

FIG. 4. THE TUBE PEDICLE IS RETRACTED REVEALING ITS DONOR SITE

FIG. 5

FIG. 6

FIG. 5. COMPLETED AURICULO-MASTOID TUBE PEDICLE—POSTERIO-LATERAL VIEW
FIG. 6. LATERAL VIEW OF THE AURICULO-MASTOID TUBE PEDICLE

riculo-cephalic angle, and reflecting over the medial surface of the auricle up to the denuded margins of the defect, measured 16 mm. With methylene blue a bi-ped flap 16 mm. wide and 68 mm. long was marked, the width of which straddled the auriculo-cephalic angle, while the length of the flap straddled a near parallel long axis of the defect. The flap was raised under 1% Novocaine and tubed, using black silk No. 000. The tube pedicle measured 4.5 mm. in diameter and 60 mm. long, the length being measured at the suture line of the tube (figs. 2–7). The tube pedicle was retracted laterally of the auricle and the margins of the auricular defect were sutured to the mastoid skin margin, immobilizing the denuded medial surface of the auricle to the denuded mastoid area, these being

FIG. 7. POSTERIOR VIEW OF TUBE PEDICLE

the donor sites of the tube pedicle. A compression dressing was applied utilizing moist cotton wads to pack in the auricular convolutions and also to immobilize the tube pedicle.

On 3 March 1947 the second operative procedure was carried out, consisting of delaying the cephalic end of the tube pedicle. On 18 March 1947 the tube pedicle was waltzed to the helix near the margin of the cephalic portion of the defect. The fourth procedure, done on 31 March 1947, consisted of outlining a post-auricular flap, conforming to the general outline of the auricle. The flap was partly raised and sutured in place and this was considered as a delay procedure. At the same time the caudal end of the tube pedicle was delayed. On 18 April 1947 the fifth operative procedure was attempted; namely, burying a preserved homogenous cartilaginous support, but after the flap was raised it became somewhat

cyanotic and it was felt advisable to replace the flap and consider this procedure as a secondary delay incision. The caudal end of the tube was waltzed to the lobe near the margin of the defect, aligning the tube pedicle in the normal location of the helix. On 26 May, five weeks following the last delay incision, a piece of preserved homogenous cartilage 58 mm long and 15 mm. wide was carved in such a fashion as to supply the posterior lost portion of the concha, carved with a concavity and the mid-portion of the long dimension of the cartilage was carved into a ridge to simulate the antihelix. The post auricular flap was raised and sufficiently undermined, reaching all along the margins of the auricular cartilage, and

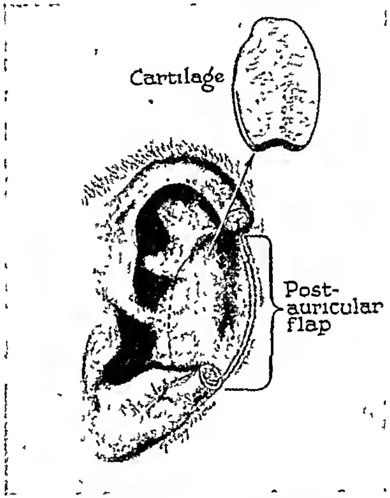

FIG 8 CARTILAGE GRAFT UNDER POST-AURICULAR FLAP

the piece of carved homogenous cartilage was inserted beneath the flap. The wound was closed with black silk Again the operative field was dressed with moist cotton wads and a compression dressing applied. This ended the sixth operative procedure (fig. 8). On 19 June 1947 the post-auricular flap with the cartilaginous graft was raised with some soft tissue medially to the cartilage, undermining the flap and the auricle up to the normal auriculo-cephalic angle and the denuded surface of the ear and the side of the head was grafted with split thickness skin graft, taken from the medial surface of the left arm, the dermatome being set at 16/1000 of one inch. The skin was immobilized not only to the margins of the denuded area but also in the auriculo-cephalic angle by through

FIG. 9

FIG. 10

FIG. 9. The tube pedicle has been waltzed to its final position. The post-auricular flap with cartilage graft has been raised and the post-auricular denuded surface sking-rafted.
FIG. 10. CLOSE-UP LATERAL VIEW OF THE RESTORED AURICLE

FIG. 11

FIG. 12

FIG. 11. ANTERIOR VIEW UPON COMPLETION OF THE AURICULAR RECONSTRUCTION.
FIG. 12. LATERAL VIEW OF RECONSTRUCTED AURICLE

and through sutures tied within the concha and also within the fossa of the antihelix. The ear was retracted to approximately thirty degrees and a dental com-

pound impression of the post auricular space was taken and incorporated within the scarlet red ointment gauze dressing, again using moist cotton wads for packing the lateral surface of the auricle and for the support of the tube pedicle (fig 9) The last procedure done on 8 July 1947 consisted of partly spreading the tube pedicle and by comparing the defect of the auricle with the normal location of the helix from a previously made stone cast of the opposite ear, the tube was immobilized in a prepared recipient site, suturing the anterior skin margin of the tube pedicle in such a fashion as to invert both skin margins and create a natural appearing scaphoid fossa (fig 10) The operative field was dressed with moist cotton wads and a compression dressing was applied

Fig 13

Fig 14

Fig 13 Pre Operative Stone Cast of the Deformed Ear
Fig 14 Post Operative Stone Cast of the Reconstructed Ear

The restoration of the auricular loss resulted in a near normal anatomical configuration (figs 8, 10–12 and 14)

SUMMARY

A case of partial auricular restoration for the loss of the middle one-third of the auricle, involving the helix and the concha is presented The formation and utilization of an auriculo mastoid tube pedicle is described The cartilaginous support was restored by preserved homogenous cartilage, while the soft tissues were restored by a post auricular flap The helix was restored by a partial spreading of an auriculo-mastoid tube pedicle The patient was a subject of marked hypertrichosis, involving not only the trunk but also the supraclavicular and post-auricular areas which deprived the operator of the usual donor sites for the formation of a tube pedicle The auricular restoration was completed in

eight surgical procedures in a five-month period. The anatomical nomenclature "auriculo-mastoid tube pedicle" localizes the donor site of this type of pedicle.

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RIGHT AND WRONG IN RHINOPLASTIC OPERATIONS[1]

A RÉTHI, M D, F I C S

Budapest

From the viewpoint of plastic surgery, the nose does not represent a thoroughly independent field Being a part of the face it forms a harmonic or disharmonic outline together with the forehead, the eyes, the mouth, the lips, and the chin On the other hand, the nose is the most projecting part of the face wherefore its role is prominent from this point of view Thus it is justified to give the nose a new shape if it does not harmonize with the other constituents of the face Not infrequently a nose the shape of which is not nice ' harmonizes with the face and its transformation may disturb the harmony While the neoplasty of a partly or entirely defective nose demands surgical skill only the corrective operation of nasal deformity—be it congenital or acquired—cannot be performed if surgical skill is not associated with an aesthetic sense The plastic surgeon should not undertake a correcting operation unless he is sure that disharmony of the face has been maintained by the nose and resoration of a due harmony may be expected by the intervention Not infrequently individuals possessing a beautiful nose and an unobjectionable facial harmony come to see a surgeon with the request that their "wrong" nose be corrected No doubt, these individuals represent psychopathologic cases and it is wise to refuse their request, first because the operation cannot do anything but much harm secondly because the patients, being mentally not entirely healthy, would not be satisfied with the result Once I had a patient who succeeded in persuading another surgeon to do the "correction" Some months after the operation he returned to me with the urgent request to restore the harm produced by the operation It was with this request that I complied, having agreed with him that the pre operative situation should be restored Thus the indications cannot be strictly defined and only general principles will be outlined A turned up nose does not match a man whereas a curved (eagle) nose nice in itself as a symbol of manhood may occasionally be considered a deformity in the centre of a gentle female face Of course, a short nose need not be distorting in a man provided that the face is adequate On the other hand, the curved nose may, especially in southern races be interesting or even beautiful If a massive nose is due to the thickness of the wall of the nose there is no operation through which narrowing of the nose could be effected It is not advisable to shorten such noses because the operation may be followed by secondary thickening and deformity If there is a projecting dorsum nasi and the patient has large eyes the deepening of the dorsum may make the eyes, somewhat outstanding formerly, seem to be exophthalmic Therefore, in these cases one should prefer the straightening of the dorsum by implantation of autogenous cartilage (ivory) or by elevating the apex of the nose

[1] From the Rhino Laryngologic Department of the St Rochus Hospital /Prof Aurel Réthi /

Fig. 1 Fig. 2

Fig. 1. At the radix nasi the dorsum forms an angle, below this place there is a projection. The beautiful eyes seem exophthalmic because of the deep site of the radix.

Fig. 2. Instead of removing the projection the line of the dorsum has been straightened by implanting a piece of cartilage. The beauty of the eyes is obvious.

Fig. 3 Fig. 4

Fig. 3. The same position as in the case represented on fig. 1 except for a second deep place between the apex of the nose and the projection.

Fig. 4. Both Deep Places Filled with Cartilage. No Exophthalmus, Fine Greek Profile

FIG. 7

FIG. 8

FIG. 7. Normal dorsum, sharply elevated tip. To fill up the dorsum would be a fa
procedure.

FIG. 8. The right solution: lowering of the tip

FIG. 7

FIG. 8

FIG 7. Normal dorsum, sharply elevated tip To fill up the dorsum would be a faulty procedure.

FIG. 8. The right solution: lowering of the tip

FIG. 9

FIG. 10

FIG. 9 Downward declination of the tip. Its correction alone is insufficient because of the underdevelopment of the chin

FIG. 10 Elevation of the apex, artificial projection of the chin by inlay

It is not the intention of this paper to deal with the operative procedures generally employed in detail. In the following, however, some cases are reported in which preceding operations had given rise to a distortion needing operative

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described above cannot occur.[3] In the course of my procedure, first a wedge-shaped piece of the septum membranaceum is removed as far as to the quadrangular cartilage. If then a linear and vertical incision is passed on the wound surface of the septum membranaceum the latter can be pressed upon the septal cartilage so as to surround its marginal part (embracing flap). Since the mucosa lying over the perichondrium has been removed over an adequate area the "embracing" flap will, on both sides, widely adhere to the cartilage whereby the drop of the nasal apex has been prevented.

Whereas the distortion following abbreviation of the nose is due to deficient skill and training the result of operation seen in fig. 15 is due to the deficient

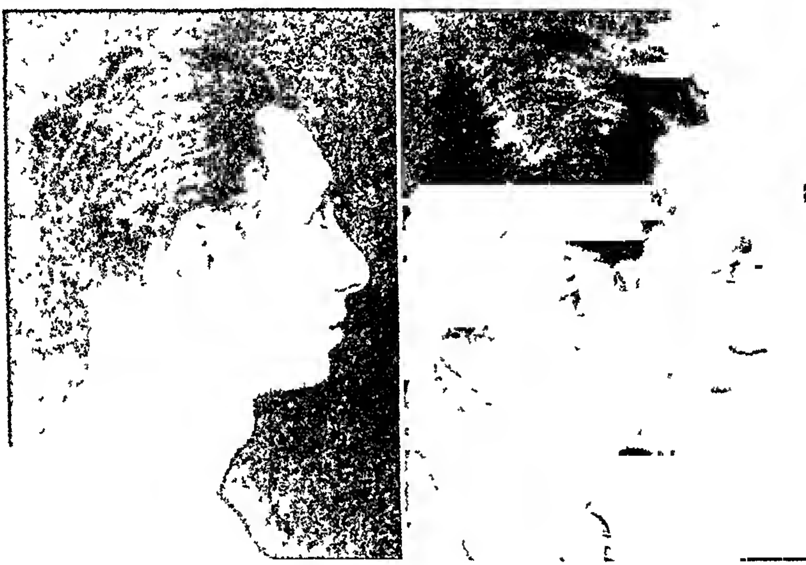

FIG. 13 FIG 14

FIG 13 FAULTY ABBREVIATION OF THE NOSE, DOWNWARD TRACTION OF THE APEX BY SCAR (RAM'S NOSE)
FIG. 14 AFTER MY CORRECTION THE PROMINENT PART OF THE CURVED DORSUM HAS BEEN REMOVED

aesthetic sense of the surgeon The girl aged 20 had a thick, projecting nose. The surgeon performed an abbreviating operation whereby the nose became very thick, very short, enormously projecting The disharmony was still more enhanced by the fact that the base of the nose was very deeply situated whereby the eyes became rather outstanding. Involuntarily, the definition of the caricature comes to mind: it is the overaccentuation of the facts Care is to be taken, lest the exaggerated execution of the plan result in a caricature. The final result of my repeated operations aiming at reconstruction may be seen in fig. 16. The nose was so thick and massive that an interior operation did not seem promising.

[3] A Réthi Raccourcissement du nez trop long. "Revue de Chirurgie Plastique", 1934: 85–106

jecting scar nodule. Besides, the surgeon had excised, with a conchotome, semicircular pieces of the alae at the upper part of the nostrils wherefore the apical part of the septum was, as seen in fig. 17, denuded. Two years later I succeeded in correcting the deformity through a one stage operation: the intra-

FIG. 17

FIG. 18

FIG. 19

FIG. 20

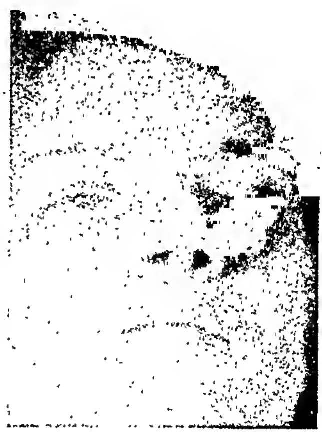

FIG. 21

FIGS. 17, 18, 19. Fault... ...r" of the nose. The apex of the nose is cicatrized, the skin of the nostrils h... op-part, been excised with the conchotome, the upper part of the septum meml... denuded, on the ap... is a scar node.
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FIG. 17 FIG. 18

FIG. 19 FIG. 20 FIG. 21

FIGS. 17, 18, 19. Faulty "correction" of the nose. The apex of the nose is cicatrized, the skin of the nostrils has, at their top-part, been excised with the conchotome, the upper part of the septum membranaceum is denuded, on the apex there is a scar node.
FIG. 20, 21. Correction: abbreviation of the nose, straightening of the dorsum, excision of triangles (basis lateralward) at the top-part of the nostrils, union of the wound edges.

nasal incision was made on the inner surface of the alae, the skin of the dorsum was elevated, the part of the dorsum deviating from the straight line removed with a saw; then the bony part which was too broad was rendered narrower by sawing through the bony wall of the nose on both sides near the basis. Finally, a triangle with a basis facing upward was excised from the septum in order to

could not be satisfactory because the large flap taken from the forehead was united with the stump of the nose without a proper elaboration. The mass of the soft parts being situated between the eyes the patient had a ram's nose, further she could not breathe through the nose because the nostrils having been contracted by the cicatrization were covered by the flap. (Fig. 22.)

The patient wished an operation allowing her to breathe through her nose, further she badly wanted a correction because she had a hope of getting married. First I excised the cicatrized wall of the air passage and covered the wound with the skin of the sulcus nasolabialis. For reconstruction of the nose, the skin of the forehead was not available as it had been used up at the first operation. The patient had rheumatism in both arms wherefore the skin of the arms could not be employed. There seemed only one approach: to build up the nose from the old flap. This procedure was rather difficult because the chief mass of the soft parts was lying between the eyes. I liberated the skin partly, in such a manner that the skin left behind was sufficient to form the radix nasi (fig. 24). Then the skin was moved toward the apex of the nose (fig. 25) until the bulk of the apex and alae was constituted. The straight line of the dorsum was assured by the implantation of a piece of costal cartilage. The final result could be regarded as satisfactory (fig. 23).

Naturally, ideal results cannot be achieved in cases deteriorated by preceding faulty operations. On the other hand, a fine nose can nearly always be attained in untouched cases. The best results are obtained by flaps taken from the forehead. The results may be considered good if the fact that the nose is artificial cannot be recognized at first sight.

ANNOUNCEMENT

BRITISH JOURNAL OF PLASTIC SURGERY

In March, 1948 it is hoped that the first number of the British Journal of Plastic Surgery will be published, under the editorship of A. B. Wallace, M.Sc., F.R.C.S., of Edinburgh.

This will contain articles by Sir Harold Gillies, Sir Archibald McIndoe, Mr. Rainsford Mowlem and Professor Paterson Ross among others.

The annual subscription is £2: 2 and the issue is quarterly.

Subscriptions should be sent to the publishers, Messrs. E. and S. Livingstone, 16–17 Teviot Place, Edinburgh, Scotland. We welcome this new journal in the field of plastic surgery, with best wishes for success.

retroauricular fistula. Thus a diplococcus form has been made the two cocci of which are contiguous in the fold. When the auricle is pressed backward the two incisions lie upon each other. The skin islet formed on the posterior aspect of the auricle covers the fistula like a lid.

Now an oval incision bordering the diplococcus shaped skin islet is made in a way that the axis of the ellipsis coincides with the fold. The skin parts lying between the elliptical incision and the diplococcus are removed. Care is to be taken that the narrow skin strip bordering the fistula be not damaged. After removal of the skin an oval wound surface has been obtained seated with its one half on the auricle with the other on the cranium while in the middle of the wound

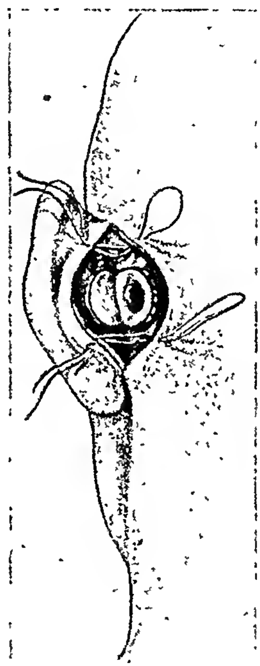

FIG. 1

the fistula bordered by a skin strip of 2 mm width is seen with a skin islet dissected off the posterior aspect of the auricle equaling in shape and size that of the fistula. Now, by pushing the auricle backward the fistula obtains its covering, besides the borders of the oval wound come into touch with each other. On closing the wound one need not unite the skin strip of the fistula with the covering skin they having a close contact securing good healing. Thus only the margins of the oval wound are sutured. To aid in this the skinborder of the oval wound should be slightly liberated. Now the so-called Donati's stitches are applied since they facilitate the union and prevent the wound margins from being turned inward. Donati's suture is essentially a mattress suture in a line perpendicular

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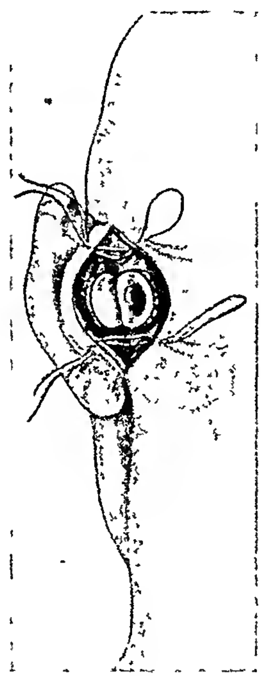

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Seeley, Robert C.. Maxillofacial Injuries. *Am J Surg* 73 551, May, 1947

The literature to date on parotid duct injuries and associated facial nerve injuries is reviewed by Seeley He reports a case and presents the surgical technic for the care of such patients This article deals primarily with the secondary repair of the dehiscent parotid duct, and the severed zygomatic and buccal branches of the facial nerve

Primary considerations in wounds of the parotid duct and peripheral facial nerve are (1) the type of injury, (2) the presence of infection, (3) immediate or delayed repair, (4) the presence of fistula or obstruction of the duct, (5) the occurrence of immediate or delayed facial paralysis and (6) the age of the patient In infancy, the repair of the peripheral facial nerve is virtually impossible due to the size of the filaments The duct, while delicate to repair, can be reconstructed satisfactorily A long standing obstruction of the parotid duct without fistula would cause gland atrophy unless frequent aspiration of the duct is made to decompress the gland In delayed cases, roentgenographic studies with lipiodol injections are used to determine the type and the location of lesions of the parotid duct Degeneration of the facial nerve may be ascertained by electrical stimulation

The case reported is that of a young adult female who sustained lacerations of the face severing the right parotid duct and the buccal and zygomatic branches of the right facial nerve Primary repair of the wound was done on the day of the accident Subsequently, there was a gradual progressive swelling of the right cheek The partial facial paralysis and loss of sensation on the right side of the face persisted Approximately 6 weeks later, at the time of secondary repair, it was found that the central portion of the duct over an area of about 1½ inches was involved in an inflammatory mass producing obstruction of the duct After excision of this mass, the gap between the parotid and buccal portions of the duct measured between 1½ to 1¾ inches There was also a gap of 1½ to 1¾ inches in the zygomatic branch of the right facial nerve

The operation was carried out under local

A SURGICAL GAG FOR EDENTULOUS MOUTHS

FRANK McDOWELL, M.D.

St. Louis, Missouri

The Denhart mouth gag seems to be more out of the way for operations inside the mouth than most gags, but is almost worthless when the molar teeth are missing. A gag has been constructed*, therefore, for edentulous mouths which opens to 65 mm. (instead of 35 mm. in the usual Denhart) and which has

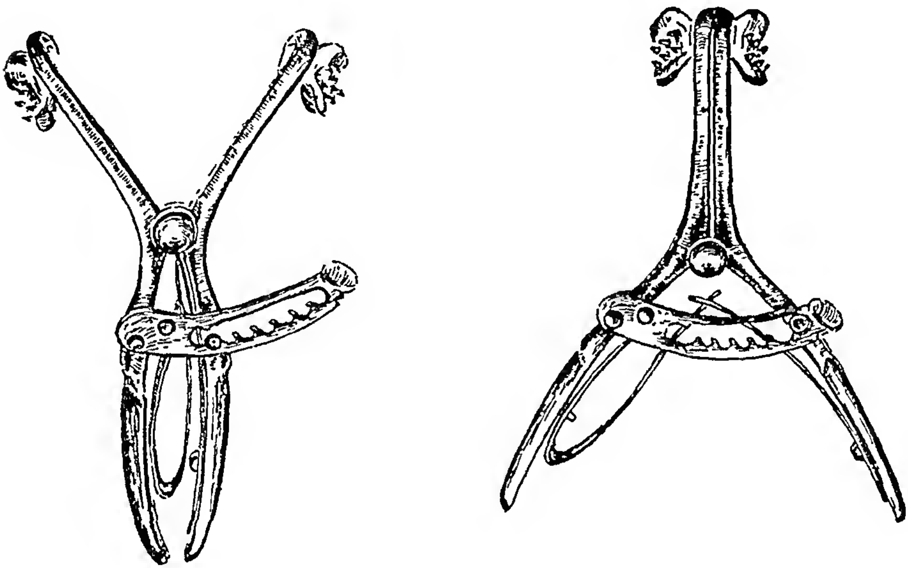

FIG. 1

small pointed teeth on the jaws that will catch in the patient's gums instead of slipping. This gag provides good exposure for major oral surgery, and the little pointed teeth are not objectionable, as most of this work is done under general anesthesia (fig. 1).

* Obtainable from H. C. Lahay Specialties Co., 4457 Forest Park Blvd., St. Louis (8), Mo.

BOOK REVIEW

It is with particular pleasure that I set aut tn review ' Surgery of the Ambulatory Patient," written by that most ahle surgean, L Kraeer Ferguson, M D , and published hy J B Lippiacott Company It was my good fortune in World War II, while serviag in tho United States Naval Reserve Medical Carps, to he attached ta the same Navy hospital as Dr Fergusoa Thus I had tho apportunity nnt naly tn know him personally hut also to ohserve first haad his fina capahilities as an all arnund surgeon

This hook is a second and mora iaclusiva editinn nf a work that first came fram the press in 1942 It surveys, in miaute detail, the vast field of affice ar ambulatory surgery More thaa 600 phatographs, drawings, and roeatgenograms illustrate the text In this 1917 volume, some deletions from the arigiaal maauscript, as well as maay additions to it, have heen made Tho latter chiefly coacern tha use af peaicillia, and chaages in ideas ahout the sulfa drugs, as applied ta tho therapy of all surgical lesions

It is tha opinion af Dr Ferguson that ambulatnry surgery is sadly slighted in the practico of modera medicine As ho effectively pnints out, it is quite prohable that much more poor miaor surgery than major surgery can ba recorded far every day af the caleadar year The reason for this, ohviously, is that miaor lesions usually come ta the attention of the younger surgeon or tho general practitioner, rather than the specialist Thus tho authar has planaed his text to fulfill tho needs of medical mea who are not highly specialized, hut who may he called upon tn perform skilled surgery in any region of the body of the ambulatory patient

The hook has threo main divisions In Part One, Dr Ferguson evaluates the rôla of amhulatory surgery, amplifying upon its advantages and disadvantages In satisfying detail, ho proceeds tn discuss surgical equipment needed for tho amhulatory patient, anes thesia, pro operatiyo preparatioa, post aperative care, dressings and bandages, specific surgical lesions, open wounds, and other related suhjects

Part Two is a comprebensivo study of regional surgery in all its diverse aspeots Here the author presents, in cacb chapter, effective techniquca for operating upon some nar rnwly defined part of the ambulatory patient's body, such as the scalp, chest and hreast genito urinary tract, arm aad shoulder, hand and fingers, et cetera, to cita only a few

Similarly, Part Three is a clinic manual aa the musculo skeletal system, taking up frac tures, sprains, and strains of the many regions of the hody Dr Louis Kaplan has added his authority to tho work by coatrihuting a section on fractures

Reading Dr Fergusoa's admirable book, even tha axperienced surgeoa must he impressed anew with tha unlimited opportuaities inherent ia tho field of amhulatory surgery To the youag man hegianing a medical career, it nffers a twn fold poteutiality to serve society where the need ia great, and ta huild fnr himself a practice as stimulating aad varied as it is rewarding, hoth spiritually and financially —Reviewed by Clarenec R Straatsma, M D

May 1948

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

INJURIES

Calvert, C. A., Lt. Col., R.A.M.C.: Orbito-Facio-Cranial Gunshot Wounds. *Brit. J. Surg., War Surgery Supplement No. 1.* Wounds of the Head, p. 119.

In a report by Calvert, out of 350 war casualties of gunshot wounds of the brain coming to the Head Injuries Hospital at Oxford, between June and September, 1944, there were 36 cases classified as being of the orbitofaciocranial group. Twenty-one other cases are included, because they present analogous problems. Included in this group of 57 cases were only those patients with wounds in whom the dura over the sinuses was seen to be torn, or was thought to be torn.

The first group (labelled frontocranio-orbital, or paranasal sinus, gunshot wounds) included those patients in whom the missile entered the skull in the frontal region and, after traversing one or both frontal lobes, made its exit from the cranium through the floor of the anterior cranial fossa, either laterally through the orbital roof or medially through the paranasal sinuses.

The second group (transorbitonasal gunshot wounds) included all patients in whom the missile passed horizontally through the upper part of the face, causing what was in effect a severe tangential gutter wound of the floor of the anterior fossa.

In the third group (facio-orbitofrontal wounds) are those in whom the missile, travelling in an upward and backward direction in relation to the head, entered the face near the orbit or nose and gained the interior of the cranium through the floor of the ante-

rior fossa, or, more rarely, the front of the middle fossa

Treatment comprises four essentials (1) débridement of the track, (2) repair of all dural tears in relation to fractures of the paranasal sinuses, (3) elimination of any obstruction to free drainage of the air sinuses into the nose which may have arisen as a result of fracture, and (4) complete closure of the scalp wound without undue tension

Where there has been extensive skin loss involving the forehead and eyebrows, a flap of scalp and a Thiersch graft may have to be used

Out of this total of 57 patients with cranio facial wounds, 4 died, a mortality of 7 per cent, including one from severe brain dam age in the thalamic region, one from pneu monia and two from infection, probably due to technical errors The cases included many with severe brain injury One patient developed pneumococcal meningitis and re covered, another developed a brain abscess, several had intracerebral aeroceles and more had cerebrospinal rhinorrhea Effective dé bridement and dural repair were carried out

Operative Approach The author's experi ence favors the view that in the majority of patients access to the wound should be by a bone flap above the level of the frontal si nuses and insertion of a fascial graft by the intradural route The intradural method is considered superior to the extradural method for dural repair There might be danger of the extradural graft perishing as a result of failure to establish an adequate blood supply

In the majority of patients, particularly when the dural laceration overlies the eth moid cribriform area, operation is best carried out through a bifrontal bone flap, with intradural repair of the dural defect In many cases, with adequate chemotherapy, this operation may be postponed for a few days

Editorial Comment Very many beautiful photographs are presented, including that of a most extensive gutter wound of the temporal fossa, frontal lobes and orbit, treated primarily by Small and FitzGibbon with a large scalp flap and free graft applied to the secondary defect, after thorough débridement of brain and orbital wound

Seeley, Robert C Maxillofacial Injuries *Am J Surg 73* 551, May, 1947

The literature to date on parotid duct in juries and associated facial nerve injuries is reviewed by Seeley He reports a case and presents the surgical technic for the care of such patients This article deals primarily with the secondary repair of the dehiscent parotid duct and the severed zygomatic and buccal branches of the facial nerve

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The operation was carried out under local

procaine anesthesia blocking the infraorbital, maxillary and mandibular nerves, with additional procaine infiltration. The incisions were made parallel to the scar, excising the scar tissue and the affected segment of the duct. The remaining portions of the duct were liberated and were threaded on No. 30 alloy steel wire. The ends of the duct were approximated with fine No. .004 silk mattress sutures through the perimucous tissues of the duct proper. Tension was relieved by a No. 2 silk mattress suture from the buccal soft tissues to the parotid facial tissues. The branches of the facial nerve were repaired with a Bunnell pull-out suture of Deknatel size No. .004. The ends of the zygomatic portion of the nerve could not be approximated and were repaired with a nerve graft, 30 mm. long, taken from the inferior branch of the cervicofacial nerve. The graft was held in place with a Bunnell pull-out. The No. 2 silk tension suture was removed, and the wound was closed by anastomosis, a No. 2 silk suture being used as a drain. The wire dowel in the parotid duct was carried through the external surface of the cheek.

In an anatomical review the author stresses the intimate relationship of the facial nerve and the parotid duct. A brief review of current literature is given, with comments.

GRAFTING

Macomber, W. B., and Patton, H. S.: Improved Grafting Technic for Burns of the Extremity. *Am. J. Surg. 73:* 684, June, 1947.

This plan of early management of extremity burn by Macomber and Patton initially demands a well-organized team of surgeons. The more important variants described are first, the use of an Esmarch bandage and tourniquet for the débridement of the lesion, and subsequent accurate placing of the graft; bleeding being controlled by the application of the final pressure dressing before the tourniquet is released. Secondly, the authors use complete blunt dissection of the burned area down to the level of viable fat. Careful preoperative preparation of the injured area and scrupulous aseptic technic are essentials. The interdigitation of the steps in grafting by the operative team is designed to save anesthesia time. The final dressing is wet saline, which is changed to Xeroform gauze on the third day if no drainage is present. With the complete elimination of infected granulation tissue as a bed for the graft, the skin transplant produces a softer, more pliable and durable skin covering.

Sander, G. B., and Lynn, R. B.: Graft Fixation Beneath Tubed Pedicle Flaps. *Am. J. Surg. 73:* 700, June, 1947.

According to Sander and Lynn, closure of the donor site beneath the tube is one of the major problems in elevating a pedicle flap on the thigh, since it is usually impossible to close the defect by primary suture.

An attempt is generally made to cover the defect with a free split thickness graft in order to avoid infection and thrombophlebitis and to reduce nursing care to a minimum.

The authors describe a method whereby the tubing of the flap and the closure of the donor site with a skin graft are accomplished in one stage, emphasizing the importance of using a dressing which will provide adequate pressure and immobilization without, at the same time, impairing the overlying tube. They describe in detail the use of a stent-type dressing of machinist's waste tied by guy sutures inserted along the edges of the donor site.

Pickard, E. W.: Repair of Bone Loss and Fractures of the Face and Mandible with Cancellous Bone Chips. *Canad. M. A. J. 57:* 556, Dec. 1947.

Pickard describes his experiences with 10 cases of non-union of the mandible treated by open operation, and bone grafting, with cancellous bone chips from the iliac crest.

These non-unions were in various positions in the mandible. Preliminary adjustable splinting was provided by means of cap splints applied to the upper and lower teeth, with locking devices. The operation is carried out through an incision through the skin at the lower border of the mandible. Bone is removed from the fracture site; the fractured fragments are placed in position to give satisfactory occlusion, and the cancellous bone chips, which are cut from the iliac crest by means of osteotomes, are put in position. The chips which were used, measured about a centimeter by ½ cm. by 2 mm. A plate of bone is also taken which is used to bridge the

gap and overlap each fragment by about one centimeter

The chips are packed irregularly, and the soft tissues sutured over them to hold them in position A drain is left in position in some patients to guard against the formation of an hematoma Despite the presence of infection in some of the cases, it was not necessary to remove this type of bone graft, and union eventually took place

Warddl, W. E. M, and Swinney, John: Bovine Cartilage in Plastic Surgery *Lancet 253* 389, Sept 13 1947

In the opinion of Wardill and Swinney, preserved bovine cartilage may be used in reconstructive surgery, with advantages not found in the use of autogenous grafts or cadaver cartilage The supply of cadaver cartilage is unlimited It resists infection, does not provoke tissue reaction, and may be prepared commercially like catgut The ease of obtaining and preparing bovine cartilage makes possible several trials for the best possible result

The most suitable bovine cartilage for use as grafts is taken from the xiphisternum The cartilage is removed under surgically clean conditions and placed in sterile dry bottles Later, under aseptic conditions, the perichondrium and soft tissues are removed The cartilage is immersed in boiling water for one minute and then preserved in sterile containers with 1 4000 merthiolate in normal saline The preserving solution is changed the following day and once a week thereafter

Several cases are reported in which bovine cartilage grafts were used satisfactorily in reconstructive surgery

Editorial Comment It is misleading to infer that preserved bovine cartilage is superior to living autogenous cartilage The former is a dead foreign body, while the latter is a living tissue graft, which remains unchanged following transplantation

NOSE

Byars, L T.: Surgical Correction of Nasal Deformities *Surg Gynec Obst 84* 65, Jan 1947

Since practically all corrections of nasal abnormalities depend largely on changing the interrelationship of component parts, Byars prefaces his general review of rhinoplastic procedures with a brief resumé of the anatomical structure of the nose He emphasizes the importance of the septum as a support to the lower half of the nose

Various procedures are discussed in the following order

Correction of hump nose It is essential that careful study be given to other facial features as well There may be present, for example, a receding chin This deformity should be corrected simultaneously with that of the nose Byars uses a plaster cast in planning a repair of this type, and carries out correction on one side of the nose

Correction of hanging columella This condition may be due to hypertrophy of the alar cartilages Correction should invariably include elliptical removal of skin and columellar cartilage The septal border should never be excised

Secondary corrections These are best accomplished after complete disappearance of post surgical reaction from major correction, and at a time when proper interrelationship of the component parts is more clearly discernible

Septal resection The supportive rôle of the septum is stressed and also the danger of excessive resection which is likely to result in a drooping tip

Drooped tip This abnormality together with a retrusion of the middle third of the face, can best be corrected by advancement of the entire tip of the nose and upper lip, including the soft tissues on which the tip of the nose rests Procedure for this type of correction is described in detail

Nasal asymmetry due to harelip Residual asymmetries of the nostrils which are usually present in unilateral and bilateral cleft lip, are described in detail together with a method for their correction

Lateral deviation of the external nose This deformity when found coincidental with septal deflection should be corrected simultaneously by the accepted method

Depressed deformities of the nose The substance of choice in correcting this type of abnormality is as a rule autogenous cartilage However, since this has a tendency to curl the author finds preserved cartilage preferable in some instances although he cautions that it possesses low resistance to possible

infection and partial absorption—disadvantages not to be overlooked in planning the repair.

HARELIP AND CLEFT PALATE

Réthi, A.: Plastic Operation for Harelip Profile. *J. Internat. Coll. Surgeons 10:* 381, May–June, 1947.

Most instances of harelip are associated with a protruding, curved nose, whereby the retracted position of the upper lip is still more emphasized and a correct image of a so-called harelip profile is obtained. In Réthi's opinion, there are two features to be corrected: the nose and the upper lip.

Absence of upper teeth or their faulty positioning may be additional distorting factors. Atrophy or deficiency of the os intermaxillare may account for the backward shift of the whole lip. Since there is no lack of soft parts, such conditions can be corrected by inserting a dental prosthesis to create proper protrusion of the upper lip. However, to replace large tissue deficiencies, especially those attended by cicatrization, Abbe's plastic operation has been suggested. In cases of widespread cicatrization, Lexer removes the upper lip and in male patients takes the grafts from the skin of the head, and in female patients, from the arm.

Réthi's technic is as follows: Under local anesthesia the incision, made with a very fine plastic scalpel, is started 1 mm. above, and medially to, one angulus oris and passed in an arc to the corresponding point on the other side. At the filtrum, the incision continues 6–12 mm. away from the rubor This incision must be deep enough to sever two-thirds of the whole thickness of the upper lip. The second incision starting vertically downward from the deepest point of the first one, parallel to the posterior aspect of the lip, approximates the rubor.

The third incision is run along an imaginary line, forming the third side of the triangle. Thus, a triangular strip has been removed from the upper lip. The portion lying below the incision is folded upward, so that it embraces the part lying above the first incision. If the inferior portion of the upper lip is to be sutured in this position, the intact skin covered by it must be removed, at least to some small degree. On the upper edge of the wound the skin should be cut off, 1 to 2 mm. wide, to secure accurate union with the inferior part. If the lip is too thin, the removal of the triangular piece of skin is not always necessary and may be used as an additional factor to the projection of the inferior margin of the upper lip. It is best to perform only the first and second incisions before attempting the third, and to test whether the soft parts can be mobilized and used for thickening the lip without the additional incision.

To obtain a "Cupid's bow" effect, the superior skin incision should be made to decline at the filtrum, thus producing a ridge unlike the inferior one, which runs along in a perfect arc. The "bow" is created by uniting the wound edges. Prior to suturing the skin the soft parts should be united by some buried stitches with No. 000 catgut.

The scar of the incision will be hardly visible if horsehair sutures are used. They should be removed after 48 hours. Before removal, the wound is secured by placing a collodion gauze strip on interspaces between two sutures and permitting it to dry.

Brown, James Barrett, McDowell, Frank and Byars, Louis T.: Double Clefts of the Lip. *Surg. Gynec. Obst. 85:* 20, July, 1947.

Brown and his associates feel that in addition to the very difficult feeding problem, the psychic shock to parents and exclamations of curiosity from others make it necessary to close double clefts as soon as possible after the baby weighs 10 pounds.

Surgical principles and operative details for single clefts are outlined, and further information regarding the treatment of the premaxilla, disposition of the prolabium, design for closure and regarding closure is fully furnished. Details as to feeding, care and general health of the patient are also outlined.

Editorial Comment: This is a well-written article, illustrated with a number of good photographs and sketches.

Spanier, Fritz: The Optimum Age for the Cleft Palate Operation. *J. Internat. Coll. Surgeons 4:* 338, Aug. 1941.

The opinions of Langenbeck, Dorrance, Warren Davis, Veau, Brown, Ernst and Halle regarding the optimum time for repair of

cleft palate are reviewed briefly by Spanier He presents an outline of the technic of repair used by each of these authors, with a diagram of the principle of closure advocated by each The importance of repair before the age of speech development in the child is stressed If the repair has been delayed until the fifth year of life, as suggested by Von Langenbeck, Dorrenca, Ernst and Halle, the patient has already developed anomalous speech sounds and has nasalized for three or more years Spanier's opinion coincides with that of Veau, Brown and Davis in recommending closure of the cleft palate at the end of the first year of life, or when the patient learns to speak His operative technic has been that of Veau, and the basis of his conclusions is derived from his experience with 196 patients repaired by this method One of the primary objections raised by the authors recommending repair at the fifth year of life has been the operative mortality in early childhood Spanier cites the low operative mortality of 1 4 per cent in Veau's group and 1 0 per cent in his own He states that in examining 146 of his own group after speech was learned, 93 per cent of those patients in whom the repair was done at one year, developed normal speech In the group repaired at two years of age, 80 per cent developed normal speech This difference was attributed to the advantage of early repair Spanier advises the operative procedure of Von Langenbeck, Dorraoca, Ernst and Halle at the fifth year of life if closure at the second year has been missed

Frahm, F W Cleft Palate Prosthesis *Dental Items 69* 219, Mar 1947

Frahm feels that when the patients are adults in cases of acquired palatal defect, the only method for correction is a prosthetic appliance unless the defect is small and conditions are favorable

When the injured patient is in late childhood, surgery should be used to correct the injury, but, should this fail to close the opening a compensatory prosthetic appliance will be the solution Surgery should have first consideration, since results, if successful will be permanent When surgery fails, the ensuing complication makes the case more difficult for the prosthetist

The author gives in detail three methods for the construction of prostheses

BREAST

Bronstein, I P, and Cassorla, E Breast Enlargement in Pediatric Practice *M Clin N Amer 30* 121 Jan 1946

Bronstein and Cassorla discuss the various types of breast enlargement encountered in their experience with children from infancy through puberty and adolescence

Breast enlargement in the newborn may appear as early as the fifth or sixth day of life It disappears, however, in a variable period of time and no interference should be attempted It is characterized by the presence of a colostrum like fluid

The pre adolescent type of breast enlargement usually occurs in girls from 8 to 12 years of age, and in boys from 13 to 18 years Its course is not predictable, as is that of the infant type Histologically, it is marked by increased physiologic hypertrophy of the periacinous tissues similar to that observed after estrogenic administration Surgery is indicated only in the absence of involution

In the overweight adolescent there is often seen a pseudogynecomastia which is a part of the general picture of obesity However, hypertrophy of the breasts has been observed in patients with leukemia, cirrhosis of the liver, tumors of the non malignant variety and following administration of estrogen Breast hypertrophy associated with an obvious endo acinopathy requires careful and exhaustive study to determine the pathological process behind the enlargement

In this article the authors are concerned mainly with the clinical aspects of breast enlargement in children and the massive involvement found in young girls

Krasner, Howard T Report on a Study of Gynecomastia among Army Personnel *Am J Path 22* 235, Mar 1946

Gynecomastia is discussed by Krasner from the standpoint of pathological anatomy, based on observation and treatment of 284 patients among Army personnel Microscopic features studied were compared with sections of normal breast secured at autopsy

The author defines gynecomastia as an enlargement of the mammary gland or glands

are discussed by Stout. The lesion was treated by amputation of the leg, followed 6 months later by regional gland dissection (the glands were negative) ending in metastases and death 5 years later.

In Stout's experience the foot and head are the commonest sites for the development of malignant melanomas of the skin; 40 per cent of these lesions are found almost equally divided between these two regions. The rest are widely scattered, lesions on the abdomen, arm and neck being next in frequency. The majority (65.4 per cent) start in pre-existing moles, and in half of the author's cases so arising there was a history of trauma to the mole. Melanomas generally kill by metastases both through the blood and lymphatic systems, and consequently the number of cures is pitifully small. There are three varieties which are less malignant than the rest, namely: (a) those which develop before the age of puberty; (b) the subungual melanomas; and (c) those which show a slow intramucosal spread, the so-called malignant freckle.

Treatment should be by wide and generous local excision, with removal of the regional node. If lymph-node metastases are present, the chances of cure are minimal or absent, except when the patient is below the age of puberty. One curious fact is the possibility of metastases from an occult unrecognized primary source. This occurred in one-tenth of his cases. Another observation is the sudden appearance of metastases producing bizarre symptoms, while the primary focus went unsuspected by the patient. Examples are the sudden occurrence of intussusception from submucosal metastasis in the intestine, bronchiecstasis from a mucosal metastasis in a large bronchus, and central nervous system symptoms from a metastasis in the brain or cord.

Cowdry, E. U.: Epidermal Carcinogenesis. *J.A.M.A. 135:* 408, Oct. 18, 1947.

Cowdry reports results of a 10-year study of experimental development of cancer in the epidermis of mice. Before any cells display malignant behavior in response to applications of carcinogen, the epidermis becomes hyperplastic. It also becomes precancerous in the sense that conditions are established in it which antedate the development of cancer. This precancerous period lasts for 10 or more weeks—a long time in the life of a mouse.

Both precancerous and cancer tissues were studied from the microscopic and chemical standpoints. Multiple chemical deficiencies appear to predominate with notable decreases in total lipid, calcium iron and biotin. Certain cell changes result from changes in the conditions of cell life, these alterations being felt more by the spinous cells than by the basal ones. This may signify that the spinous cells suffer more from calcium (the chief component of the predominant white ash), and perhaps from other deficiencies, than do the basal cells nearer the source of supply in the underlying dermis. Abnormal mitoses are more conspicuous in the spinous-cell than in the basal-cell layer.

The concentration of calcium in human epidermis is almost the same as in mouse precancerous epidermis and in human and mouse squamous-cell cancers. Not only is the total epidermal calcium decreased in carcinogenesis, but the amount of free diffusible calcium becomes much less. The invasiveness of growing cancers may be correlated with the increase in the proportion of free or diffusible calcium to bound calcium and the decrease in total calcium.

In addition to the breaking down of the cohesiveness of cells by the calcium deficiency, there is a spreading factor that increases the permeability of the ground substance of connective tissue. The idea has some justification that to prevent spread, decrease in the calcium content of epidermis must be corrected and antihyaluronidase must be supplied to counteract the hyaluronidase (experiments have shown that hyaluronidase facilitates the spread of experimental cancers).

This study, according to the author, indicates the possibility that multiple deficiencies of essential components of the epidermis make the conditions of cell life therein difficult, predisposing to mutations having survival value. Some of these mutations may constitute the malignant transformation. The decrease in epidermal calcium may favor the breaking away, and initial invasion of the dermis by malignant cells.

PLASTIC SURGERY ROUTINE FOR SURGICAL HOUSE STAFFS*

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PRE-OPERATIVE ROUTINE

There are a few pre operative requirements for a patient who is to have a plastic operation that have to be added to the routine general "work up" of surgical patients It may be assumed that the usual examination and precautions are taken for these as for any surgical patient whether local or general anesthetic is to be used and includes the arrangements necessary for special procedures

The resident surgeon should see each new patient as soon as he is admitted, introduce himself, and see that the patient is made comfortable and that all of his immediate wants are taken care of He should write a short admission note in the chart, see that the intern and laboratory have definitely been notified of the patient's admission, and order any special procedures necessary It is his special responsibility to see that the pre operative "work up" is complete and promptly done, and to overcome any apparent obstructions or delays that might prevent this, even to the point of doing some things himself that he might ordinarily delegate to others The kindness and efficiency of the house officers in these initial contacts are very important to the patient's morale, as he judges his probable post-operative care from them He should be made to feel that the resident surgeon is also his personal physician while he is in the hospital, and that the resident will promptly investigate and act upon his complaints

Photographs and x-rays are often the most important part of the whole record and should be made as soon as practicable after admission

The patient should be examined carefully for any evidence of skin infections or eruptions as even one small pimple any place on the body may be a contra indication to some operations

It is highly important that patients rest and are free from annoyances the night before operation and the morning of operation before being called to the operating room. For limited operations, and especially those to be done under local anesthesia, there is no special reason for the patient's being bothered with the enema that is included in "routine preparation for operation", and a definite order to omit enemas should be given Another order that can often be left for the patient's advantage is "do not waken patient in the morning until time for the hypodermic"

A light sedative is desirable for most adult patients the night before operation

*From Barnes and St Louis Childrens Hospitals and Dept of Surgery, Washington University, School of Medicine

Nembutal gr. $1\frac{1}{2}$ (.09 gm.) or similar medication may be given at bedtime and repeated once if necessary in two hours.

For patients requiring extensive operations, it is also very desirable to have excess fluid and glycogen in the body before operation. Therefore, fluids may be given to within two hours of the operation, and extra carbohydrate equal to 6–8 oz. of sugar may be ordered for the afternoon or evening before operation, except for diabetics; or the chloroform routine may be followed.

The resident should see the patient again at or before bedtime and make a final check to see that the "work-up" is complete, that all reasonable precautions have been taken, that all of the desired pre-operative orders have been left and are being carried out, that the patient is as comfortable as possible and will probably get a good nights rest. If there are any probable contraindications to the contemplated operation, or if consultations from other services seem desirable, the staff surgeon should be notified as early as possible (except for ward patients where the resident may immediately procure consultation from the residents of the other services). If the resident is to be away from the hospital on any particular evening, he should delegate this final "check-up" to some house officer who is sufficiently mature and experienced to assume this responsibility, and who is familiar with this routine.

SPECIAL PRE-OPERATIVE SHAVING AND WASHING

Cleanliness is essential for success in this type of surgery and should never be taken for granted, even in meticulous persons. In nearly all operations, it is desirable for the operative field and adjacent areas to be washed with soap and water the night before, and unless there is some special contraindication, a complete tub bath should be ordered, and someone should see that facilities are provided for the patient. Whenever possible, the hair should be washed if it is to be included in the post-operative bandages, or if incisions are to be made in or near the hairline.

Operations on the Face. Men should come to the operating room recently shaved and women without cosmetics on. Definite orders should be written to see that this is carried out.

Shaving. Leave definite orders as to the area to be shaved. Ordinarily, this should include all areas which will be exposed at the time of operation and which need it, except that *eyebrows are never to be shaved.* If there is a chance that a split graft may be necessary, have one thigh shaved clear around from the inguinal region and top of the buttock above to six inches below the knee, except when it is definitely known that the graft is to be taken from another donor area (e.g., chest or back), or the graft is to be applied to the face, inside the mouth, or inside the orbit. In the latter instances, *do not* shave the donor area; this is to be sure that hair-bearing skin is not transferred to these places.

Hands and Feet. Shave and wash from the elbows or knees down, clean and trim nails.

Patterns. If patterns are outlined on the patient's body, do not let anyone wash them off.

Dressings. If the patient has a wound in or close to the operative field, it

should be carefully cxamined, cleaned, all adhesive removed, any adjacent shaving necessary done, and a clean small dressing put on tho night before opcration. See section on burns for pre-operative treatmcnt of larger wounds.

Mouth Hygiene. All patients having general ancsthetics, and all patients having operations in or near the mouth should have special atteation paid to cleaning the mouth bcfore operation. See that toothbrushes, dentifrices and mouthwash are available and that instructions are given. Ordinarily, patients should not wear dentures or removal bridges to the operating room, *unless* the operation is of such nature that the contour of the mouth and lips is important. In operations to change the contour of the nose, and in some others, it is important for the paticnt to keep aay dentures that he has in his mouth during the procedure.

PRE-ANESTHETIC MEDICATION

Local Anesthesia

In the normal adult patient, the usual sedation is given the night preceding operation. The morning of opcration, he is to he givcn Nembutal or Seconal gr. 3 (.18 gm.) one and a half hours before operation, and Morphine gr. $\frac{1}{6}$ (.01 gm.) plus Hyoscino $\frac{1}{2}$ cc. thirty minutes before ho is expccted to be opcrated on. If there is any question of sensitivity to barbiturates or opiates (after specifically questioning the patient), consult the staff surgeon. *Do not give morphine to children or elderly people* without consulting the staff surgeon as to the exact dose. *Do not give morphine or atropine to patients with obstructed breathing.*

General Anesthesia (including sodium pentothal)

Infants and young children are not to reccive any premedication, unless specially ordered by thc staff surgeon. Children of normal size and aged 4–10 years can have $\frac{1}{300}$ gr. atropine thirty minutes beforo operatioa to aid in checking mouth secretions; this dose can be givcn to children as small as 2 years who are having skin or cartilage grafts put in about the face whcre salivary contamination might endanger the grafts—and it can be increased to $\frac{1}{200}$ gr. in larger children in this group. Childrcn under 10 years do not ordinarily gct pre-operative morphine.

Children of normal size and aged 10–14 ycars can havo Morphine gr. $\frac{1}{16}$ to $\frac{1}{12}$, and Atropine gr. $\frac{1}{200}$, thirty minutes before operation.

Adolescents should reccive doses gcnerally larger than the above, but smaller than adult doses.

Adults ordinarily receive Morphine gr. $\frac{1}{6}$ (.01 gm.) and Atropine gr. $\frac{1}{150}$ (.0004 gm.) thirty minutes before operation, unless there is some reason to suspcet sensitivity to either of these drugs. $\frac{1}{4}$ gr. (.015 gm.) morphine is *not* used as a pre-anesthetic drug on this serviec. Elderly people will require a reduction in the dose of morphine to gr. $\frac{1}{8}$ (.008 gm.) or less. *Do not give morphine or atropine to patients with obstructed breathing.*

Chloroform Routine

Chloroform is the safest aaesthetic, in some instances, when using the cautery or surgical diathcrmy ahout the mouth. If tho following routine is followed

closely, late chloroform poisoning due to free HCl in the liver can practically be eliminated. All patients (except diabetics) who are to have such operations should be put on this routine as soon as they enter the hospital, unless it is definitely known that they are not going to have chloroform.

Pre-operative. 1. Force fluids and carbohydrate diet. It is desirable that the patient be putting out sugar at the time of operation, and this can be attained by giving these things:

a. Lemonade with a whole lemon and 4–6 tsp. sugar to each glass. Give 240 cc. every 3 hours until 2 hours before operation.
b. High carbohydrate and high protein diet.
c. Candy.

2. Give sodium bicarbonate 2 gm. every four hours.
3. Urinalysis the morning of operation to see that sugar is present.
4. If the patient has not put out any sugar, make arrangements to give 500 cc. 10% glucose intravenously during the operation.

Post-operative (3–4 days). 1. Continue with the fluids, diet and sodium bicarbonate as soon as the patient is able to take them. Lactose or dextrin can be substituted for sucrose if desired.

2. Give glucose intravenously as necessary.

The reason for the routine should be explained to the patient and the nurses because with cooperation it can be a very simple thing.

Routine Laboratory Work

Hemoglobin, red count, white count, differential, urinalysis and blood Kahn test is to be obtained on all hospitalized patients unless otherwise ordered. It is particularly important to obtain hemoglobin readings as early as possible on all cleft lips, cleft palates and patients having large skin grafts, neck dissections, or extensive operations for the removal of cancer. Such patients should be transfused pre-operatively, if necessary, to bring the hemoglobin level up to 11–12 gm.%.

Blood for transfusion should be cross-matched, checked and available on call at operation for all neck dissections, large skin grafts and extensive operations for cancer.

Bleeding and clotting times are to be taken on all cleft lips, cleft palates, and cases of extensive dissection or undermining as well as patients having large skin grafts or those with a suspicious history. Abnormalities should be reported to the surgeon before operation.

Determination of total blood volume may be considered in chronically ill patients for long operative procedures.

Early Morning Rounds

The intern must see all pre-operative patients before he goes to the operating room and check up on their preparation. He is to report to the resident and to the surgeon any variation from the normal T.P.R., laboratory findings, or any skin eruption. The resident on the service is directly responsible for this work, and

it is his duty to see that no patient comes to the operating room not prepared for the proposed operation

The resident must see all patients operated on the day before, all seriously ill patients, check with the interns about the pre-operative patients, see that adequate teams are provided and that they are up in the operating room ready to start on time

OPERATING ROUTINE

Sufficient instruments must be sterilized A list of operations with the required instruments is kept in the operating room If there is any doubt about the neces sary instruments, have the operator check them over before operation

The scrub nurse and her tables are to remain sterile throughout the morning and *no one* is to touch her or her tables at any time She is not to touch any part of the operative field, the other members of the team, or the Mayo table Instruments and sutures are to be dropped on the Mayo table by her, or handed directly to one of the operating team with forceps Do not allow any instru ments to go back to her large tables without resterilizing Use the Mayo table exclusively The instrument man should keep the Mayo table straight and clean at all times All blood should be removed from instruments as soon as they are put down Any small pieces of clotted blood adhering to instruments fall into the wound and are foreign bodies and perfect culture media Fresh blood on them keeps the operator from seeing as much as possible

A great deal of time can be saved between cases by having instruments ready for resterilization as one operation is being finished *Be sure all instruments are cooled off before putting them into the operative field or on the Mayo table*

In handling instruments try to keep the fingers off of them as much as possible Grasp them in the middle and never hold them with the fingers on the points Respect delicate and sharp instruments at all times—they are priceless when you need them

Do not throw instruments, or lean on patients that are being done under local anesthesia Never allow a knife to lie on a patient

Antiseptics

Use tincture of iodine diluted with alcohol to the color of weak tea in the preparation of all operative fields Do not allow it to streak down out of the field because after the alcohol evaporates, the excess iodine will burn the skin Paint over wide areas so that it will not be necessary to paint over towel edges Towels with iodine on them will almost always cause a burn, and should not be left in place Extreme care should be used so that none of this will get in the eyes

Use aqueous 1 5,000 zephiran for preparation of the conjunctiva and in cases done under local with open wounds

As soon as possible, learn the proper method of draping patients for the more common operations These details have been carefully worked out and there is a *best* way of doing it in each instance

Alcohol is always to be put in a red glass Cocaine, pontocaine, adrenalin,

zephiran, or any other solution not safe for subcutaneous injection, should never be put in ordinary clear or blue medicine glasses or in a white cup. They should be put in a red glass, or other identifying container, held by a member of the team until used (*not* put on the Mayo table), and promptly discarded.

All hands and feet are to be scrubbed with soap and water, dried with alcohol and ether before the usual preparation with weak iodine.

Local Anesthetics

1. Adrenalin is not used in novocain solutions in raising flaps.
2. Always ask the surgeon how much adrenalin he wants in NaCl novocaine solutions.
3. Always put 2% novocaine in a blue glass and ½% novocaine in a clear jar or white cup (alcohol in a red glass).

Quiet Operating Rooms

The marked advantages of a quiet operating room and environs are obvious and can be had by the active cooperation of all. This is particularly important when operations are being done under local or hyoscine, as patients are apt to misunderstand or misinterpret remarks made at such times. The charge nurse and resident are responsible for the cooperation of their staffs in this and the latter should be encouraged to develop the habit of listening so that any necessary conversation can be in low tones.

Operating room teaching is very important to everyone concerned. However, experience has shown that it is not best accomplished here by long recitations, or by the "question and answer" program technique. Invariably, those who learn the most and the fastest are the most acute observers and listeners.

POSTOPERATIVE ROUTINE

The interne or anesthetist is to stay with the patient as long as there is the slightest necessity. Many patients on this service are subjected to continued hemorrhage and blocked airways. It is absolutely imperative that some responsible person, either house officer or an anesthetist, should remain with the patient until he can be safely turned over to the care of the nurse on the division. When there is any doubt, the interne or assistant resident should follow the patient directly to the room and give any indicated therapy.

After all mouth operations, the patient should be turned on his abdomen or chest so that fluids can run out of the mouth. If there is any trouble with choking while still asleep, the patient should have his head lowered or carefully held hanging over the edge of the bed, or a pillow should be put under the chest to allow the patient's head to hang low. *Do not put patients flat on back* when there is any question of bleeding or excessive secretions into the mouth or throat. If they are awake enough to sit up, the head should be elevated. For pulling tongues out, use large towel clips. *Do not use* tongue forceps.

Before leaving the patient with a nurse, be certain that the airways are open and that the respiratory exchange is free and easy. This is judged by the amount

of air being exhaled through the nose and mouth, as compared with the effort the patient is putting is putting into it Chest movements indicate that the patient is trying, but are no index to how much air he is getting in and out If the exchange is not free and easy, adjust the mouth or nasal rubber airways to different levels and suction the throat If this doesn't relieve it, loosen any neck dressings, pull the tongue forward (with a towel clip), feel back in the throat for any loose packs or clots and remove them, and secure any assistance necessary *quickly* Don't waste time giving CO_2 to a patient who can't breathe be cause of a big blood clot back in the throat

Patients who have had a mouth operation, or who have a bandage around the neck, or in whom there is any reason to believe there might be obstruction to the airway, should have a suction machine in their room when they return following operation, with the division nurse in attendance The suction catheter should have only one hole, it should be in the end, and cut obliquely The tube should be small enough that it will go through the mouth or nasal airways back to the throat, the suction machine should pull at least 12–15 lbs, and the nurse must know how to use it *These patients are never to be left alone even for a minute until fully awake!*

Tissue specimens and cultures to be prepared by the interne and special care to be taken to see that they arrive safely at the laboratory The outcome of many patients is dependent on the laboratory report

Water should be given by mouth (unless specifically ordered otherwise) as soon as awake and post nausea If vomiting won't hurt the patient, fluids should be encouraged so he may vomit and automatically wash his stomach out

Correction and maintenance of each patient in proper fluid and electrolyte balance is the immediate concern of the house officer Unless contraindicated, give parenteral fluids intravenously, rather than subcutaneously, and never give the latter in the thighs when it can be avoided. Patients may complain of sore, aching, thighs from subcutaneous saline for weeks after they have recovered from their operations

The house officer should consider every patient on the service as his own private patient and do everything possible for the safety and comfort of the patient, and do it without delay *Diets* should be increased rapidly and checked up on from day to day, both with the patient and with the nurse in charge Unless the operation presents some contraindication, most patients can be on a regular diet the following day, as far as the general anesthetic is concerned Patients who have no teeth or dentures, or who have their jaws wired together, should be ordered on a *non-chewing diet* consisting of a regular diet which has been put through a food grinder or puree mill (the usual hospital "soft diet" is mostly toast and bacon and is not satisfactory) Tube feedings are usually preferable to intravenous feedings if the patient cannot swallow, but has no other disturbance of the gastrointestinal tract Special diets may be ordered on occasion, but be certain that they are appetizing enough that the patient will eat them Do not hesitate to call in the dietitian for help if the patient is not eating If the patient is vomiting for no known reason, think of possible fecal impaction

or sensitivity to codeine or other opiates. A patient who is not eating is unhappy, and will usually make everyone around him unhappy until something is done about it.

Sedatives

For adults usually order codeine 1 gr. (.06 gm.) and aspirin 10 gr. (.6 gm.) q 4 hrs. P.R.N. for pain and Nembutal $1\frac{1}{2}$ gr. (.09 gm.) as necessary for sleep at night. The codeine may be given hypodermically as long as he is nauseated, or hypodermic morphine may be substituted if it is thought that he will have an unusual amount of pain or is unusually sensitive to pain. In cases with any question of respiratory embarrassment or depression, morphine will have to be given with caution or best not at all, substituting some lighter sedative that will not depress respirations.

Infants and very young children should have little or no postoperative sedation unless unusually restless. Older children may have small doses of aspirin (or occasional tiny doses of codeine when absolutely necessary) and 4 cc. elixir luminal at bedtime if needed. Opiates are dangerous in children unless carefully controlled.

Merely writing P.R.N. orders for narcotics is no assurance that patients are being kept free of pain, as they may not know to ask for them. This point should definitely be checked during rounds on the early postoperative days and "stat" orders given additionally as necessary.

Do not give morphine or other sedatives to patients with painful eyes or tight bandages without investigating the condition and making any necessary corrections. The assistant resident or resident is to be called for these complaints—not the interne.

Tight bandages can ruin a postoperative course. Morphine will not relieve the pain they cause and it would be unfortunate if it did. Examine the areas complained of and carefully loosen or cut that portion of the bandages if necessary. It can usually be fastened with adhesive and rarely needs to be changed. If there is any question, do not hesitate to call a more experienced person for advice in this situation or in any other.

Eye bandages are to be removed, when complained of, and the eye, and especially the cornea, carefully examined. *Do not give morphine* before examination. Corneal ulcers and conjunctivitis, from ether or other chemicals or from turned in lashes or foreign bodies, are very serious complications and every precaution should be taken to prevent them. After examining the eye, be sure the lashes are all turned out and no foreign bodies are present, wash out the eye thoroughly with saline, instill white vaseline (*do not use* anesthetic ointments), and close the eye again. (If it is necessary to remove any stitches between the lids, call the surgeon first.) If the patient is not immediately relieved by this procedure, or if there is any suspicion of a corneal ulcer, call the surgeon immediately, day or night.

Sponges for use in the eye should be of cotton, and the solution of saline, boric, or aqueous 1:5,000 zephiran. They should be handled with lysol-free forceps, as $\frac{1}{10}$ of a drop of lysol can cause a very painful conjunctivitis. Use sterile forceps from the instrument pan to handle these sponges.

Benzene is very useful for removing adhesive tape with minimal pain, and there is seldom any excuse for pulling off tape without it (Ether is not as good and nauseates persons who have had a general anesthetic) However, it should be used only in small amounts on cotton balls, or small sponges, lifting up one corner of the tape and gradually sponging it loose from the under surface It should never be allowed to streak down into dressings or binders for it will always burn the patient when confined On open surfaces after evaporation, final traces can be removed with a small alcohol sponge Alcohol frequently causes a burning sensation when applied to skin that has been covered with adhesive, but if put over small areas at a time and washed off immediately with water or boric solution, less pain will result and a large field can usually be gotten clean Benzene is also useful fro removing ointment crusts with the same precautions

Dressings

Since wound healing is the essence of Plastic Surgery, intelligent handling of open wounds and simple mechanical cleanliness is of primary importance Wounds, surrounding areas, dressings and binders must be kept clean Soaking in a tub can be used to prevent sticking and pain when removing large dressings *Open wounds* are always dressed with fine mesh gauze, either wet or with grease on it *Wet dressings* may be put on so that they stay wet (bulky, with waterproof coverings and changed every 12 hrs), or with rubber tubes leading out of them so that more fluid may be added every 3–4 hrs , in which case the dressings are changed every 24 hrs Frequently, it is much better to change the whole dressing 2 or 3 times daily, cleaning the wound with white soap and water as often as necessary *Grease dressings* consists of just one layer of fine mesh grease gauze (any bland ointment such as merthiolate, xeroform, or scarlet red) with all the excess grease scraped off, and covered usually with a larger pressure dressing They are used only on more clean wounds and should be changed every 1–2 days as necessary Each time, any grease crusts around the margin of the wound should be removed with ether or benzene, and the whole wound washed gently with white soap and water *Suture lines* are always covered with fine mesh grease gauze to keep the stitches from adhering to the dressing Sutures are carefully removed as soon as one is sure the wound will not separate and the wound edges are supported for a time after that with fine mesh collodion gauze, adhesive, elastoplast, or some combination of these

Pressure dressings are of fundamental importance for good quick healing and are used on all wounds, unless there is some special reason for omitting them

Mouth washes and oil nose drops should be used regularly for most patients postoperatively whose comfort and cleanliness will be helped at all by them (Oil nose drops are not used in small children because of possible aspiration) Order tooth brushes for patients who present themselves without them, get the mouth cleaned up quickly, and have it kept clean

Summary

On regular daily rounds, the house officer should always check the following 5 points on each individual patient (1) How well he is eating, (2) how well

he is sleeping, (3) relative freedom from pain, (4) bowel movements, (5) whether the dressings are clean and secure. These are minimum essentials to be investigated in addition to the TPR and any specific complaints. Fecal impactions and decubitus ulcers are always regarded as signs of poor care.

FEEDING TUBES

1. Should be well anchored to the body so they can't be swallowed or fall out. Use a #14 or #16 soft rubber Levine tube.

2. Adhesive should make at least one complete turn around the tube, but any grease on the tube should first be removed. Keep this adhesive clean by frequent changes.

3. *Always test the tube immediately to see that it is not in the trachea.* Hold the end of the tube to your ear and listen as the patient breathes—put the end in a glass of water for a minute, if necessary, to see if air is being exhaled through it. Then try to aspirate stomach contents from the tube. If not obtained, place your ear or a stethoscope over the patient's stomach and inject a syringe-full of air down the tube. If it is in the stomach, a gurgling noise will be heard. When these tests indicate that it is probably in the stomach, inject 4–6 cc. sterile water through the tube; if there is no cough or distress the tube is probably in the esophagus or stomach. After this, one can inject 50 cc. water through the tube and then adjust the tube upward or downward until it can be completely aspirated back into the syringe. This indicates that the tube is at the proper level

4. A golf tee should be kept in the end of the tube, or a rubber band tightly around the folded over end, to prevent regurgitation each time the patient coughs or moves around in bed. Metal clamps hanging on the end of these tubes are a nuisance to the patient and tend to pull the tube out by their own weight. Tape the external portion of the tube to the patient or his dressing so that it is not swinging around in his way all of the time.

5. *Diet.* Full directions are in the last part of these notes, for patients who are probably going to have the tube in a week or longer, or who present a nutritional problem. Write out the formula and have the whole thing sent up from the diet kitchen. Go over the use of the diet with the nurse, dietitian and patient and explain that this is considered medicine as well as food and that each 24 hrs. the full ration ordered is to be given and not to have part of it left over in the ice box to be thrown out.

Well nourished patients who are going to need the tube only for a few days can receive 400 cc. regular liquid diet and water up to a total of 2500–3000 cc. daily rather than the routine above.

6. Tube should be rinsed with water after each feeding.

7. Put P and I drops in the nose around the tube 1–3 times daily.

8. Change the tube, if practical, from one side to the other about once a week, or if there is ever any ulceration caused by the tube. Do not disregard comcomplaints of pain in the larynx, as necrosis of the cricoid cartilage has resulted from feeding tubes. *Do not ever* remove feeding tubes without consulting the surgeon.

TRACHEOTOMY ROUTINE

Patients with actual or suspected respiratory difficulty are to be watched closely on the ward and the surgeon in charge kept posted frequently, as sudden changes in the patient's condition and even sudden death are apt to occur.

The technique of tracheotomy should be read by the house officer in charge, and he should keep in close touch with the ward at all times. The tracheotomy set, novocain, and gloves should be ready at the bedside of the patient.

These patients make a great effort to breathe, but they gradually wear out. Become familiar with the signs of upper airway blockage so that you can quickly recognize it. These are:

1. Unexplained and increasing restlessness. The patient may be awake and rational and still unable to tell you why he is restless, but he wants to get out of bed and pull at his neck dressing. The nurses may be requesting orders for restraints or for morphine. He is struggling for air and such orders might easily be fatal.

2. Intercostal and suprasternal retraction with each inhalation—sometimes dilatation of the alae nasi.

3. Increasing pulse rate means that the heart is being taxed and at this stage the trachea had better be opened (unless it can be quickly relieved otherwise) rather than to allow the patient to carry on an uphill fight against the obstructed airway.

4. *Cyanosis is a late sign*—sometimes even a premortem sign and indicates that the patient has lost the battle. It is usually followed soon by a drop in blood pressure and loss of consciousness. Tracheotomy is imperative at this stage, though it may be too late. It is important to be able to quickly differentiate cyanosis due to heart failure, atelectasis, pneumonia, and upper airway blockage.

Morphine is never given to these patients because it may be just enough a depressant of the respiratory center to stop its function. Atropine is not given, because it may dry out the airway enough to allow one part to stick to another and occlude the passage. It is necessary to keep the trachea moist. Light sedatives may be used.

Quickly size up the situation and see if there is any simpler and quicker means of clearing the airway than tracheotomy. Cut off any neck bandages. Examine the throat digitally and visually for any loose packs or blood clots—suction out any saliva or blood. Pull the tongue forward, and put a Magill airway through the nose and down behind the tongue or just over the glottis if the obstruction is due to tongue blockage. Do not persist in these efforts unless immediate relief is obtained.

Tracheotomy should be done early and in the operating room if possible. *If in doubt open the trachea.* It is very much preferable to open tracheas with deliberation and careful dissection, but regardless of how or when it is done, the opening should always be below the first tracheal ring. To open higher may result in a laryngeal stenosis. The thyroid isthmus may be cut through if necessary.

When done deliberately, a horizontal incision may be used through the skin and subcutaneous fat. Separate the ribbon muscles vertically in the midline and retract them to either side. Identify the 3rd and 4th tracheal rings, cutting the thyroid isthmus between two clamps if necessary. Get the field dry, so that blood will not run into the trachea, and pick up one of these rings with a hook and hold it forward. Have suction ready and open the rings vertically with a stab blade knife, being very careful to not stab into the posterior wall of the trachea. Insert the tube, remove the obturator, and suction any secretions out of the trachea.

Moist inhalations and the use of ammonium chloride or potassium iodide may be advantageous if secretions are thick. If there is any sign of heart failure, secure immediate medical consultation.

Explain to the patient and his relatives that he will not be able to talk while the tracheal tube is in place and provide him with pencil and paper.

If the patient swallows with difficulty insert a feeding tube through the nostril. But advise the nurses about the danger of giving too much liquid at a time so it is apt to regurgitate and overflow into the larynx. Small sips of water or cracked ice can still be taken by mouth. If the feeding tube further embarrasses respiration (before the trachea has been opened) it should be removed.

After the trachea is open, give special instructions to the nurses about keeping the inner tube clean and free of clots of blood. Pipe cleaners are the best thing to use but any gauze or cotton that can be pushed through it with a probe will do. *The care of the inner tube.* It should be kept clean and it should be boiled at least twice a day and whenever else there is any special contamination. It should be scoured inside and out with Bon Ami each morning. If there is obstruction to breathing present even when the inner tube is clean, there may be a plug over the lower end of the outer tube, and if so, the whole tube should be removed and cleaned.

If left in very long, the tube may become foul and the whole inside of the trachea will develop a very offensive odor that is possibly due to a pyocyaneus infection; so that the whole tube should be taken out and cleaned as necessary. When the whole tube is out being cleaned, care must be taken that the opening does not contract so much that it can't be introduced again. The time limit of keeping the tube out may not allow for sterilization and cleaning the tube, and if not, an extra tube of the same size and length should be on hand to put in as soon as the dirty one is removed.

Change the dressing around the tube and the tapes as often as they become dirty.

In all manipulations of the tube, be as gentle as possible. Try not to touch the sides of the trachea with the lower end of the tube, as to do so irritates and starts violent coughing. Each time the inner tube is put back in, a drop or two of glycerine may make it slide easily. A tracheal tube that is too long or poorly shaped may press on the anterior wall of the trachea and cause hemorrhage or necrosis.

Limit the patient's visitors the first few days to prevent annoyance. *Always have pencil and paper on hand for him to communicate with those around him.*

Nothing on a ward is any more obnoxious or distressing than a tracheotomy case with a dirty dressing, partly obstructed tube from lack of being cleaned out, thrashing around in bed unable to get attention to the simple things that would make life fairly comfortable for him and much more pleasant for all concerned. Most of the attention necessary is a plain matter of cleanliness, and though the patient is on P.R.N. dressings, the whole outfit should be gone over carefully at least once a day by the intern or resident.

CANCER CASES

Tongue, Mouth, Face, Larynx

Be sure the history contains a chronological sequence of events, with special reference to advice given by doctors and previous treatment.

Chloroform anesthetic routine.

Blood grouping and matching if indicated.

Clotting time. Daily B.P. Careful consideration of patient's physical condition by both house men and medical consultation if advisable.

Preparation: Be sure sufficient area is shaved. If there is an open ulcer present, have it clean with a fresh dressing on it when the patient comes to the operating room. *See that the inside of the mouth is clean.* Order a tooth brush and soap and have the patient take good (scrubbing) care of his mouth during the whole preoperative stay in the hospital, and resume this as soon as possible after operation.

Postoperative: Parenteral fluids calculated to body requirements.

Every effort should be made to give these patients rest and sleep. A restless night may start them on a downhill course.

Feeding tube and care: See instructions in these notes.

Dressings: Mechanical cleanliness is all important.

Change dressings first on advice from suregon.

After the first dressing, change daily. Irrigate wound if possible, remove loose slough and pack holes with iodoform gauze, soaked with Balsam of Peru. Keep surrounding areas shaved and as clean as possible.

These dressings get soiled very easily and the care with which these patients are dressed has a great deal to do with their recovery.

Packs should be removed as they become soaked with pus and new ones carefully inserted. No cavities should be allowed to remain without gently and loosely packing gauze in them or maintaining firm pressure from without.

To allow two dirty surfaces to be bathed in their secretions means almost certain secondary hemorrhage.

Often it is desirable to have pressure upward under the chin in dressing these cases so that a loose flap may be held in contact with deeper tissue. Learn to apply a Barton type bandage and use it on these patients. It gives upward pressure without too much on the throat. A sloppy dressing hanging loose on the patient is depressing to the patient and to everyone concerned.

Do not use iodoform gauze if radium has been used or is to be used.

Have patient move around in bed and out of bed for short intervals as soon as possible.

B.P. twice daily.

NECK DISSECTION

Have one unit (500 cc.) of whole blood typed, cross-matched, and ready for transfusion at operation, in addition to routine laboratory work. Whether cautery is to be used or not, put on chloroform routine. Get daily B.P. Very careful physical examination and consideration of the resident as to whether the patient is in good enough condition to go through with the operation. If in doubt, let surgeon know so medical consultation may be obtained without delay.

Shave hair one inch away from level of top of the ear around, down, behind. Find out if cautery is to be used. Have patient scrub teeth several times the day before operation. Shave chest to nipple line.

Postoperative: Pressure dressing applied at time of operation will usually have to be changed in 48 hours. Leave drains in 7 days. Change dressings every other day or as often as necessary, and be sure flaps are held down to avoid fluid collecting under them. Sutures can be removed between 7 to 10 days, if flaps are well enough healed.

Force fluids, and get sufficient in, immediately postoperative through any or all channels.

Feeding tubes will often be necessary the first few days and are very advantageous because with them the patient can be getting all necessary fluid and 2500–3000 calories day after operation. Keep the mouth clean by washing and swabbing it out.

Blood pressure twice daily. Have patient move around in bed and out of bed for short periods as soon as possible.

ROUTINE CARE OF FREE FULL THICKNESS SKIN GRAFTS

Skin eruptions are contra-indications to these operations especially, and patients should be thoroughly examined for any sign of them at the time of the regular physical and again the morning of the operation. If anything is found the surgeon should be told before the anesthetic is started. If large grafts are to be taken, the bleeding and clotting time should be determined.

Be sure there is an adequate area of preparation, both at the site of operation and at the place the graft is to be taken from. Do not shave hair from the abdomen or thigh if the graft is to be put on the face, because the operation will want to stay clear of the hair bearing area.

If grafts are to be put on the face or neck of burn patients, be sure that adequate atropine is ordered to avoid excess saliva that may be very troublesome.

Dressing in operating room: The graft is covered with fine mesh grease gauze, then plain gauze; cotton waste or a marine sponge is then placed over the whole area and a pad over it. A snug bandage is then applied so as to obtain an even elastic pressure over the whole graft. Extra care must be taken to immobilize

the parts and prevent slipping; and to prevent vomitus from getting under dressings.

If satisfactory, this dressing is to remain in place 6 to 8 days. It can then be removed and some or all of the stitches removed. Dressings should be done as indicated. If the area is perfectly clean, the same type of dressing should be reapplied and there is no use changing it for several days if there is no slipping and no sign of infection.

If blebs occur, they should be opened and all dead epidermis removed. The area should be painted carefully with 10% merchurochrome or some suitable mild antiseptic. Sloughs should be removed where possible and especially so if pus tends to creep under them. If there is infection present, wet dressings of 1:5000 zephiran or saline should he used and kept moist at all times.

If blood clots are present, the graft should be carefully incised, the clot emptied if possible, and the skin edges allowed to drop down in place. It is not necessary to trim the edges away unless they are infected.

ROUTINE CARE OF THICK OLLIER-THEIRSCH OR THICK SPLIT GRAFTS

Patients with large raw areas must have hemoglobin and plasma proteins checked preoperatively and transfused when low. Have additional blood ready for operation if indicated. Recheck these the day after operation.

The same care applied to the preparation of tho patient and to the care of these grafts as to the full thickness ones except that, since they are apt to be put on dirtier fields, they are usually dressed on the 4th–6th day, and the postoperative pressure does not have to be kept up so long.

The dressing is applied as under full thickness grafts, if the area is considered clean enough. If the graft has been put on an old ulcer or x-ray burn that is known to be unfavorable, a wet dressing is applied with plain fine mesh gauze next to the graft instead of the grease gauze, and with the pressure dressing the same, but with tubes in the dressing to allow the addition of saline. This wet dressing that has to be kept on three to four days sometimes becomes messy and of bad odor, but it seems to be definite that grafts will succeed in some dirty fields this way that would probably be lost with the regular grease dressing.

The sutures are usually removed at the first dressing, the dead overlapping edges cut away, and either a grease or wet dressing reapplied as indicated by the condition of the graft and wound or surrounding cellulitis. If infection is present the dressing should be changed at least daily.

Dressing the donor site of a thick split graft: Two layers of fine mesh grease (usually scarlet red) gauze are placed over the area from which the skin is taken, and strapped firmly in place with adhesive almost around the leg. This dressing, if done accurately and firmly, splints the part very well and sort of replaces the skin that covered it. If it slips around or is loose there will be a great deal of pain. *Do not remove the layer of gauze next to the skin as long as it is stuck unless it can be soaked loose.* To do so tears away all the fresh epithelium under it, delays healing and causes extreme pain. A larger dressing can be put over this

and plastered or bandaged, and this outer one changed before 12 days if necessary for cleanliness. At the end of 12 days there is usually complete healing and no further dressing is necessary. If there has been infection or the graft has been cut too deep, there will be markedly delayed healing that will require careful care until epithielization is complete.

CARTILAGE TRANSPLANT CASES

When it is desirable to use the patient's own cartilage, close check should be made for any respiratory infection. Shave body from umbilicus to clavicles.

Have long hairs out from nostrils. Swab out nostrils night before and morning of operation with 3% Tr. iodine and alcohol 1–3, or other mild antiseptic.

Asepsis should be rigid through this operation. Do not put the fingers in the chest wound nor on the cartilage, handle all instruments without touching the points and when the cartilage is being handled do it with forceps exclusively.

Dressings. Chest. Middle strip of adhesive on chest to go clear around and lap over. This is to prevent pain as much as possible. Any rubber drains out in 48 hours. Skin sutures out 6–7 days, any stays out 10–12 days. Watch closely for development of any respiratory infection and especially so if the pleura has been injured.

Face: The dressing put on in the operating room and those following are essentially the same as for an osteoplastic operation on the nose; consisting of thin malleable aluminum splint supported by adhesive strapping. These dressings are changed, usually after 48 hours, by the surgeon.

If the transplanted cartilage is used any place other than the nose, get special instructions from the surgeon about the care of the wound.

Sterile preserved homogeneous cartilage may be used for transplantation. This is stored in a refrigerator at 4°C. (40°F.), in 1:1000 colorless aqueous merthiolate for 2 weeks at which time a culture is taken, and if negative 1:5000 colorless aqueous merthiolate substituted. Two weeks following this, after another negative culture, the cartilage is ready for use. It may be kept in the refrigerator several months, changing the merthiolate solution each week and culturing it each week.

ROUTINE CARE OF CLEFT LIP AND CLEFT PALATE PATIENTS

Preoperative

Check hemoglobin immediately upon entry and give preoperative transfusion if it is too low. These children are often anemic because of feeding difficulties and the mortality and morbidity of the operations can be lowered and wound healing made better by getting it up to reasonable levels before starting. The level required varies with the operation contemplated; palates and double lips are apt to lose a good deal of blood at operation; single lips lose much less. In any event, none of these children should come to operation with a hemoglobin level of less than 10 gm.%. If there is any further question, have blood crossmatched and on hand for possible use during or after the operation.

Take clotting time before operation. If clotting time is over 4 minutes take

bleeding time. Do not schedule young infants for operation if jaundiced (notify the surgeon). Question parents of older infants about previous vitamin C intake (be sure it has not been orange soda pop). Excessive bleeding is a hazard in these operations which should be avoided by all possible means.

Check for any respiratory, skin, or mouth infections. Nearly all children with open palates have a chronic otitis media which is not a contraindication to operation. Operations are not done, of course, during acute exacerbations. The appearance of the drum, leukocyte count, and temperature enter into the decision; if there is any question, have the pediatrics resident or some other experienced person look at the child. Many young infants with open lips will get milk crusts along the nasal septum and the diagnosis of thrush may be made by one who is not familiar with the situation. Do not make this diagnosis until an experienced person has seen the lesions. If treatment is necessary, use borax and glycerine or anything besides gentian violet if possible.

Never allow these children to come to the operating room in a dehydrated condition. Give maximum amount of fluids (milk, etc.) for 24 hours before operation. *For infants,* give milk until 4 hours before operation, and then 6% sugar water until 1 hour before operation. *For older children,* omit breakfast but give clear fluids by mouth to within 2 hours of operation. These children often arrive at the hospital about 4 p.m. and miss supper because of examining routines. This is to be avoided by commonsense measures. If they are too upset to eat or drink right away, see that they are offered food and liquid later until they take it, *especially the liquids.*

No morphine or atropine for infants. Older children may have small doses of atropine.

Make special check the morning of operation on the patient for any skin or respiratory infections or irregularity of the T.P.R. If found, notify the surgeon before the anesthetic is started.

Congenital heart disease is frequent enough in these children that it should be carefully looked for in each patient and the surgeon notified if there is any question of it.

Postoperative

The patient is kept in the operating room under the care of a special nurse or anesthetist until it is certain that the airway is open, that bleeding has ceased and that shock is not present.

Hemorrhage and other postoperative complications. Turn on face until it is seen that the bleeding is controlled. If no bleeding occurs in 15 to 30 minutes, allow child to assume a more comfortable position. Repeated swallowing may be a sign of bleeding.

For depleting hemorrhage the surgeon should be notified to carry out appropriate packing of the palate flaps or under the lip.

Difficult breathing not due to blood in the pharynx is usually due to:

a. In lip patients to obstruction in the anterior part of the mouth.

b. In palates probably to pressure of the packing. In palate cases see that

the packing does not hang down into the pharynx. If due to lip or intraoral obstruction insert a rubber tube into the mouth or pharynx past the obstruction and fasten the tube to the cheek. Of course, care must be taken that the pressure of the tube does not open up any suture line. For double cleft lip use 2 tubes, for single cleft lip use one tube. Restlessness may be due to respiratory obstruction or to excessive loss of blood.

Postoperative Laboratory Work

Determine hemoglobin on 1st postoperative day and transfuse if less than 10 gm.%.

Diet. Give water as soon as the infant or child can take it, within one-half to three hours after operation. Vomiting will help to clear the stomach of blood. In cleft lip cases resume feeding as before operation, but do not put to breast or give bottle for a few days. Use dropper, cup or spoon for the first few days. For palate cases feed with sterile dropper, spoon or cup, fluids or very thin semi-fluids for two or three weeks. This should, of course, be of sufficient caloric value to prevent loss of weight. *Do not give nipple to cleft palate cases at all.* Feed with sterile spoon, cup or dropper with rubber tip.

Care of Wounds

In cleft lip cases keep the suture line and sutures absolutely clean of blood serum by frequent sponging until dry with small square pieces of gauze 1½ cm. square soaked in alkaline antiseptic solution. Do not use cotton as it sticks to the sutures. This is especially important the first few hours after operation, as at this time there is apt to be some blood that will be almost impossible to get off if allowed to dry. The resident should be responsible for either himself or the interne going over each lip at least once a day and removing whatever crusts he can that the nurse has failed to get off. If the lips are kept clean however, this is not necessary. Persistent bleeding from the nose or lip for more than 3 hours should be reported to the house men and they should gently pack the nostril or see that pressure is kept on the lip.

In cleft palate cases:

a. Give a little water (warm) after each feeding to cleanse the mouth.

b. Administer 3 drops of 1% merchurochrome in each nostril twice daily.

c. If the child is perfectly tractable irrigate the mouth with saline and paint the suture line with 1% merchurochrome three times a day, *but do not cause a palate child to cry or struggle.*

d. Do not allow anyone to place a tongue depressor in the mouth or to gag a child after palate operation as the sutures may be torn out; unless a serious throat infection is suspected.

Keep child's hands away from mouth and wound. Use arm cuffs. These must be kept on continuously and must be of sufficient strength to really keep the fore-arms extended. For large children, anterior wood splints firmly padded and firmly strapped and bandaged on are preferable to the cloth cuffs.

For temperature of 103 degrees or over sponge and notify plastic resident and

he may get immediate pediatric consultation if necessary. Most common cause is an acute flare-up of the otitis media.

Sutures. Superficial lip sutures and sutures in the nose are to be removed the 4th and 5th day. The suture through the plates at the side of the nose is to be removed usually on the 10th day, unless there is some contraindication such as the floor of the nose separating. The stay and mucosal sutures under the lip are also to be removed on the 10th day. *Extreme care is necessary in removing these sutures.* If the knot is cut off of one of them, leaving a free piece down in the tissues an abscess is sure to result and a sinus continue as long as the foreign body remains. *If there is uncertainty about being able to get any stitch out do not cut it.* A whole stitch does no damage and will finally loosen so it can be removed.

Sutures in cleft palates are not to be removed. These work out themselves, though remaining ones may be taken out in 1–2 months time.

Packs.

Under lips, remove in 24 hours.

In palate incisions remove in 48 hours. If uncomfortable remove at 24 hours. Anterior packs, after palate setback, are removed in 5 to 7 days.

NASAL OPERATIONS

The interne should clip the hairs out of the nostrils the night before operation and clean all crusts out of the nose. The inside of the nose is to be cleaned again the morning of operation.

The cold packs that are usually applied to the eyes postoperatively are to be gauze flats wrung out of ice water. Do not use rubber gloves full of cracked ice.

All of these patients will have a little oozing of blood for a few hours after operation. If excessive, or if it restarts after once having stopped, notify the surgeon. If he is not available immediately, call one of his associates for instruction.

HYPOSPADIAS REPAIRS

Postoperative Care

If a catheter is in place, the house officer should test it daily by injecting water and aspirating it back. The test of a catheter's efficiency is being able to get the water back. The catheter should be irrigated twice daily by the nurses with sterile water (*do not use boric solution*) and should be drained every 2–3 hours into a sterile pan (do not attach to a bottle). See that the catheter is well anchored at all times. Do not remove it and do not replace it without consulting the surgeon.

If a pressure dressing encircles the penis, the circulation of the tip should be noted within 2–3 hours, again that evening, and at least twice daily after that by the house officer.

If the patient is returned to the ward without a catheter in place, definitely check to see if he has voided by 8 or 9 p.m. and if he has not, notify the surgeon immediately.

Accurate output is to be kept on all patients.

POSTOPERATIVE CARE OF FLAPS

The circulation of the very end of the flap must be checked by a house officer within 2 hours after the operation, and then every 2–3 hours until bedtime; after that, twice daily. Note blanching of end of flap when pressed and how quickly color returns. This end of the flap can be exposed by a small hole in the dressing, which can be kept covered between times.

Good pressure is to be maintained at all times on the part of the flap which is being transferred, but the pedicle must be loose, free of pressure and kinks.

POSTOPERATIVE BLEEDING

This complaint, whether made by a nurse, patient or relative, is never to be negated. It must be personally investigated immediately by a responsible house officer, day or night. Experience has shown that it is impossible to evaluate this complaint by telephone conversations, and the possible consequences are too serious to delay investigation.

PREPARATION OF COTTON MECHANICS' WASTE FOR PRESSURE DRESSINGS

Waste has proven satisfactory for most dressings. It is cheap, easily handled, more easily prepared for use, and much more easily incorporated in a dressing than marine sponges.

The waste can be obtained from Wallworth & Co., 326 S. Delaware Ave., Phil. Pa., from Wiping Materials Company, 2028 North Main, St. Louis, Missouri, or other supply house, and it is necessary to specify the short, fine thread, bleached variety. The bale is autoclaved at 30 pounds for 1 hour, then opened and suitable amounts resterilized in drums, jars or wrapped packages for handling *at the time of operation. The clean nurse takes it on her table and hands it out* as required. It is hoped to have surgical gauze companies get this supplied in large sterile packages to avoid the trouble of sterilization.

Marine sponges may possibly be used and should be of good quality, large soft wool form, and they should be bleached. This does not injure them, does not cost any more, and helps in general in handling and having the dressing appear clean. They are not to be handled by the clean nurse and are not to be put directly on wounds—in other words, their sterility is only relative and is not to be relied upon except relatively. Waste, in contrast, can and often is put directly in contact with the wound, and is generally much more useful and adaptable.

These marine sponges are prepared by beating the loose dirt out, washing in soap and water, and then soaking in 1–1000 $HgCl_2$ for 48 hours. They are then washed in saline, allowed to dry and stored dry. They should not be stored wet, but can be kept in drums or sterile wrappers.

FEEDINGS

This outlined liquid diet can be used in all cases with feeding tubes, in all cases with jaws wired either open or closed, and in all cases where a liquid diet is necessary. The continued routine use of it makes it possible to keep these patients

up to normal weight or even to gain weight, and it allows almost a full diet to be given the day after operation.

Average Feedings

70 KILO./150 LBS. BODY WEIGHT 2500 CAL. PER 24 HOURS		
	gm.	*Cal.*
P	125	500
F	100	900
Ch	300	1200
Total		2600

Average Tube Feedings

P	75	300
F	100	900
Ch	350	1400
Total		2600

Liquid Feedings

	OZ.	CC.	P. GM.	F. GM.	CH. GM.	CAL.
6 eggs	6	180	36	30		450
20% cream	8	240	8	48	8	480
Milk	24	720	24	24	48	480
Tomatoes strained, canned	6	180	3		6	36
Glucose, sugar or Karo	10	300			300	1200
Salt, 1 tsp.						
Total	54	1620	71	102	362	2646

Mix the sugar or Karo and milk, and then add the eggs, salt, tomatoes and cream. Divide the whole thing into 5 feedings and give with syringe through tube at 7 a.m., 11 a.m., 3 p.m., 6 p.m., and 10 p.m., preferably slightly warmed. Give approximately at a swallowing rate.

This mixture is advocated primarily to simplify the procedure for ward patients, so that they will be more sure of getting their full ration, *but where possible the ingredients should not be mixed together but should be prepared as nicely and as appetizing as possible.* Many attractive things can be made and flavors, chocolate, fruit juices, ice cream, etc., can be added as desired.

Give at least two oranges or lemons as sweetened fruit juice between feedings each day, and the patients may have all the water, coffee, tea, fruit juice, ice cream or other special food that is permitted. [(Replace to feeding tube care.) When a feeding tube is in place, if the patient can swallow around it a little at a time, this can be permitted, except in laryngectomy cases. *These cases are to have nothing by mouth.*]

Take 8 ounces of ground lean beef and soak in 8 ounces of water over night.

Store covered in an ice box, strain through a cloth in the a.m., and add the fluid to the total feeding. Leave out 2 ounces of sugar. To get a fuller protein ration, it is desirable to add lean scraped beef or fresh beef juice.

If there is too much volume for 24 hours, 6 ounces of Dryco or Dextrin can be substituted for the 24 ounces of milk, and for further reduction, the vegetable juice or beef juice may be temporarily omitted.

EXTRA FOODS	CAL. PER OZ.	P	F	CH	CAL. PER OZ.
Milk	20	1	1	2	
		3.5%	4%	4.5%	
Cream 20%	60	1	6	1	
Eggs 1 per oz	75	6	5		
Beef Loin, cooked	60	8	3		
Karo	120			30	30
Dryco	125				
Oatmeal	110	5	2	20	
Potato	35	1	0	6	
Bread	90	3		18	
Rice	110	3		24	
Butter	240		25		
Orange 1	40			10	
Vegetables 5%	6	0.5		1	

THE MASSIVE COMBINED TUBE AND OPEN FLAP USED AS A UNITY ROTATION PEDICLE TRANSPLANT FOR REPAIRS OF CERTAIN DEEP SURFACE DEFECTS*

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INTRODUCTION

The most prominent and well known technique in pedicle flap plastic surgery is the one or two stage type of flap coverage used in extremity repair The understanding and use of this method, popularized by the war flood of patients, runs parallel with the disseminated knowledge about free skin graft coverage These procedures are extremely valuable when properly applied There are, however, certain situations which are not amenable to the rapid techniques Here we are primarily concerned with this aspect of the coverage problem The transplants presented are combinations of both the tube pedicle and open flap These united structures require multi stage operations They are indicated in massive deep surface destructions involving the extremities where mechanics prohibit the use of shorter procedures

In deep surface repairs the flap and tube form the basis for definitive tissue replacement These structures are applied to the recipient site without interrupting the continuity of the donor vascular supply. When the fibrous and vascular tissue of the recipient site have become adequate for complete attachment the transplant no longer requires its donor nutritional connection This interrupted by section, permits the recipient part to return to its independent function

The open flap and the tube have been used in a multitude of ways The former has been applied directly and offers immediate complete coverage The latter is usually swung on to the recipient site after an intermediate operation It is subsequently unfolded to match the defect size These two structures, the tube and the open flap, are combined to form the transplant under consideration The tube pedicle then forms the basic stalk which enables the attached soft tissue flap, utilized for major coverage, to be transported to the recipient area Discussion of these structures, the tube and open flap, as independent types and their indications will add clarity to the massive unity transplant presented Pertinent points recorded come from observations on some 4000 soft tissue transplantations

THE OPEN FLAP

Open flaps composed of skin and subcutaneous tissue are short and broad in shape They are placed directly on the recipient site The raw areas, both donor and free flap base, are free grafted in order to present a completely healed

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postoperative lesion. In cases where all denuded areas are "skin dressed," the sectioned pedicle can be immediately imbedded. This second operation then completes the reconstruction.

The abdomen is the common site for open flaps. They are employed mostly for elbow, forearm and hand replacements. Their utility is available depending upon the surgeon's ingenuity and ability to apply general surgical principles. With absence of infection, presence of hemostasis, construction sufficiency and proper indications, success in this transplant is assured.

Flaps in general are constructed so that they completely cover the defect. They are attached without tension and in a manner so that the free area of the flap, joining the body completing the vascular continuity, does not bend or kink. If this allowance is not observed, nutritional supply is jeopardized. Small sharp bends may, if subjected to subsequent edema, be converted into pressure kinks which will destroy the vascular supply to the transplant. The periphery of the flap should be carefully approximated to the wound circumference. The adipose flap base should lie upon a recipient bed presenting a good minute blood supply. Unless these situations are met, failure is likely to occur.

It is an axiom that all tissues should be handled gently. The young man full of energy and strength is apt to be hard handed. Blood vessels within transplants, pulled, twisted, and pounded may come to subsequently contain thrombosis of sufficient magnitude to destroy valuable segments.

Postoperative pressure properly employed is valuable. It enhances approximation and inhibits venous stasis. If used, it should be applied cautiously and checked repeatedly after application. A hazard sometimes overlooked occurs when transplants or migrated adjacent tissues for immediate closures are superimposed over bony prominences. Spreading uniform pressure on top of soft tissue in such a location is intensified by the subjacent unyielding protrusion. In this way, not only may local necrosis occur, but also distal segments of flaps may be lost.

In lower extremity re-surfacing for deep surface defects several methods have been found satisfactory. The immediately rotated flap has been useful with a skin graft covering the denuded site. This type of tissue transfer properly done carries added circulation to the recipient area. Parallel double pedicle shifts can sometimes be used where lesions are susceptible to these reparative procedures. Rapid repair, shortened convalescence, and facilitated postoperative care are the benefits of both these methods.

The cross-leg open flap has been utilized and can be a one-stage affair depending upon its location. In general, for lesions on the lateral leg or foot, cross-leg pedicles will have to be located in situations, which because of blood supply, necessitate a delay procedure to augment vascularity. Meticulous surgical care is paramount. An improperly or inadequately delayed flap will subsequently show marginal or continuity losses. Flap destructions due to improper design or surgical techniques are dreadful things and greatly multiply hospital time.

By and large, lower leg flaps are easier and more certain to be successful than thigh transplants. Thigh flaps are indicated, however, when a larger amount of

subcutaneous tissue is required They may also be indicated where a cross leg flap has been previously lost, or there are amputee prohibitions Inner thigh tubes and reverse suprapatellar flaps in general are successful

THE TUBE PEDICLE

Skin tube pedicles, as separate units, have been employed extensively in plastic reconstructive procedures They are indicated for coverage where open flaps cannot be conveniently designed The skin tube offers a clean healed soft tissue transplant which has migratory features not otherwise attainable The discussion of their construction is of importance here because they form the nutritional attachment from the donor to the massive open flap enabling its rotation into the defect area

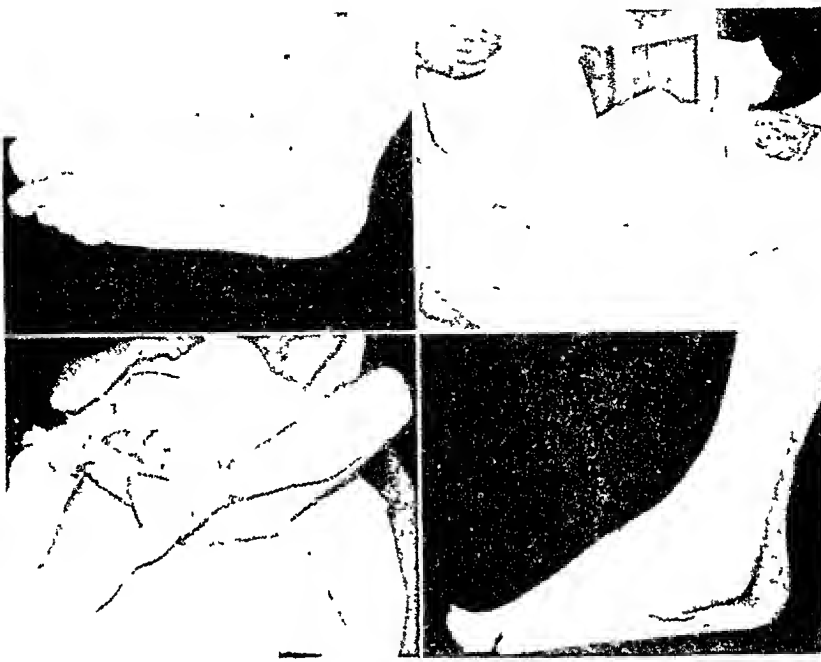
Tube pedicles are constructed in general not greater in length than three times the width Where linear dimension is insufficient, increases may be had by interval bridges These are eliminated when circulation is adequate To begin tube construction, paralleled incisions are made through the skin and subcutaneous tissue This mass of soft tissue is undermined completely using care not to buttonhole the fascia Complete control of bleeding vessels not only in the fascial area but also on the flap adipose tissue base is imperative If hemostasis is neglected or masked by novocaine adrenalin anesthetic, it may subsequently spell disaster

The tissue flap properly prepared has its cut edges united forming the skin tube Closure of the subjacent denuded area is brought about by a variety of methods depending on the location, size of the tube formed, personal experience, and training of the surgeon When tubes are small, adjacent undermining of soft tissue mobilizes it for closure This, if done, should always be accomplished without tension If the latter is present, healing usually occurs with scar formation The width of scar is directly proportional to the degree of tension If the tube is to be as large as that required in the rotation tube open flap transplant, under consideration, closure of the donor area by free skin graft is preferable This, used to cover the fascia subjacent to the newly formed tube, is fixed in place by multi suturing Early in the treatment of young men with war service injuries requiring such procedures continuous black silk sutures were utilized to fix the graft These were run periodically through the entire graft area occasionally biting down through muscle Such a suture was a source of pain with postoperative movement Those individuals, who were prone to disregard direction, moved very little in the area involved This fixation method was employed to overcome small nuisance losses variously placed resulting from independent exercises assumed by the patient during the first few postoperative days Contraindications to such methods of suturing are the inevitable stitch scars These make little difference, however, when the object is a skin dressing with complete rapid healing and the location is such that the area will be subsequently covered by clothing

The alternative method, a more polite technique, holds the free graft by stent fixation A pattern dressing is cut and set into the depression over previously

applied vaseline gauze superimposed on the graft. This stent dressing is held in place by tying long silk sutures over its summit. These sutures unite approximately in the middle of the area having extended, periodically spaced, from the donor site periphery. In this way the recipient area and skin graft are immobilized against a firm dressing surface. This method of graft holding is quite successful. If the area is clean and dry, there is no indication for cutting holes

A B



C D

FIG. I A DEMONSTRATES THE DEFECT
Previous sequestrectomy and free skin graft coverage offered a healed wound presentable for definitive surgery at an early date.

FIG. I B. ILLUSTRATES THE CONSTRUCTED ROTATION COMBINED TUBE AND OPEN FLAP READY FOR ATTACHMENT TO THE RECIPIENT SITE
The donor open denuded area was immediately free grafted. The construction on the thigh is indicated when a larger amount of subcutaneous tissue is required, in face of previous cross-leg calf loss or because of amputee prohibitions.

FIG. I C. THIS IS THE APPEARANCE AT THE END OF THE THIRD POST-OPERATIVE WEEK
The rotation tube stalk is ready for section and immediate inset. Coverage is adequate for subsequent orthopedic reconstruction.

FIG. I D. SHOWS THE TRANSPLANTATION COMPLETED

in the skin graft. Such incisions serve no purpose, waste time, and only scar up the graft. Given proper hemostasis, tension and graft approximation correct, absence of infection, and a good minute blood supply, the take will be one hundred percent.

Tubes should be situated on the body surface in such places that they come to incorporate important parts of the vascular tree. A tube or flap containing a

good artery can be built and migrated with considerable speed. Ordinarily tubes should not be constructed across the midline. Exception to this is found in the transverse neck tube. The same holds true for flaps crossing the midline, used in conjunction with tubes, folded back for lining. Here even with considerable time the anastomosis is never quite good enough to completely carry the tissue if it is of any size and it is abdominally located. In the thoracic area, however, success is not uncommon. Flaps and tubes should follow the physiological direction.

THE MASSIVE COMBINED TUBE AND OPEN FLAP

This massive rotation transplant is not a common procedure but finds its applicability in extensive losses of soft tissue surface not amenable to other types or repair. It is employed successfully here in large shoulder reconstructions and thigh inguinal replacements. The method may also be used in thigh foot replacements. The combined tube and open flap, on an intermediate carrier, makes large masses of abdominal tissue also available to the lower extremities. Here the construction is preferable to the open flap attached directly to the forearm if the requirement is for length of transplant in excess of width or when approximation difficulties are expected.

Preoperative planning for the transplant is important. For arm and shoulder replacements the combined tube and open flap is located on the back and lateral chest wall. The rotation tube stalk is constructed in the trapezius position extending distalward and laterally fanning outward on the thoracic wall to include the large open flap. The open flap, after plastic construction is complete, can be swung onto the defect area by the lateral displacement of the tube stalk. The vascularity is insured through the tube until the take in the recipient area is complete. The denuded donor area is free grafted. After the transplant is in place and the tube is sectioned, the operator, if he wishes, may open the remaining stalk and replant it into the trapezius area. For thigh-inguinal area deformities, the rotation transplant can be built upon the lower abdomen making use of the inferior epigastric artery. This combined tube and open flap is constructed in the same way as the shoulder thoracic one. The tube is formed at the first operation and the attached open flap outlined by a superficial scalpel grazing of the skin. Constructed this way, the design is established and eliminates re-measuring at subsequent surgeries.

When combined tubes and open flaps are to be formed and are to be quite large, as in the cases presented, to insure vascular adequacy before actual migration, a planned delay technique is required.

To completely form a flap and separate it from its bed with replacement before transfer is not considered a true delay procedure. The proper technique to insure vascular reinforcement would be a designed staged separation of the flap from its bed. In the cases described three operations would usually be required to establish a complete delay of the distal open flap making a total of four operations before construction transfer. The plan here employed consisted first of elevating the vascular retrograde half of the open flap. Three weeks later the

A B C D

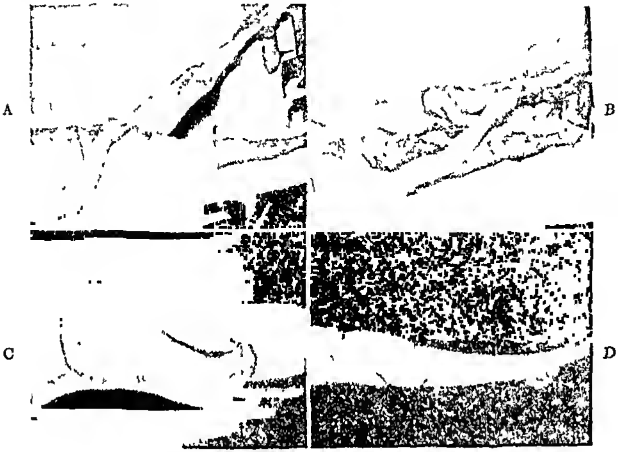
FIG II A SHOWS THE COMPLETED COMBINED TUBE AND OPEN FLAP READY FOR MIGRATION TO THE RECIPIENT AREA
The donor tube site has been skin grafted

FIG. II B DEMONSTRATES THE OPERATIVE APPEARANCE
The massive open flap is rotated by means of the tube stalk to the defect site

FIG II C. THE SURGERY IS COMPLETED, THE OPEN FLAP IS IN PLACE, THE DONOR AREA IS SKIN DRESSED

FIG. II D. DEMONSTRATES THE ABDOMINAL DONOR AREA INDICATING THE SIZE OF THE OPEN FLAP
The rotation tube stalk has been returned to its original position. The coverage is complete.

vascular directional half was undermined and replaced. Two to three weeks following this operation, the distal border extremity was incised and the wound edges immediately reapproximated. If one is skeptical the base junction of the open flap and tube stalk can be left adherent while the halves are elevated. Separation of this connection and complete elevation up to the distal border would then be an added step. An alternative method would be to first elevate the



FI(... E OF THE EXTREMITY DEFECT
... tube and open flap transported
by ...

fla ...
purchase ...

FIG. III C. DEMONSTRATES THE COMPLETE VIABILITY OF THE ENTIRE TRANSPLANT FROM ABDOMEN TO EXTREMITY
This was a reverse pedicle transplant in the abdominal position

FIG. III D. COMPLETED TRANSPLANT IN PLACE
The coverage is adequate for subsequent definitive surgery

junction, then the halves and finally incise the distal border. The distal corner areas could be left intact until the last operation. The method employed depends upon individualization of cases.

The combined tube and open flap as a unity transplant formed of abdominal tissue can also be utilized in lower extremity situations where massive soft tissue replacements are required, or where a previous calf flap has been lost, or in am-

an attached soft tissue area from the abdomen with a thicker corresponding layer of subcutaneous adipose tissue. Where large intermediate carrier transplants are necessary and the abdomen is quite fat, transplantation is accomplished with less hazard if general diet reduction first removes the fatty excess. After the migration has been accomplished, and the patient regains the weight, the transplant may return more or less to its primary thickness.

SUMMARY

Attention is directed to a unity type of pedicle flap used successfully in the repair of massive soft tissue destructions. References are made to methods of construction and indications.

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PRIMARY REPAIR OF TOTAL AVULSION OF SKIN FROM PENIS AND SCROTUM*

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Numerous reports of this type of injury are recorded in the medical literature Mechanical conditions predisposing to avulsion injuries of the external male genitalia are common Most frequently they are seen in the harvesting fields where unprotected rotary shafts and gears may catch the trousers of the worker, and by a twisting action, draw the scrotum and penis into the machinery The primary repair of these injuries, that is, within a period of several days, has not been attempted often Early repair should be undertaken whenever possible because of the prolonged disability necessarily following delay

In 1942, Neal Owens reviewed a total of 13 cases of avulsion injuries of the penis and scrotum that were recorded up to that time Since then, Leon Sutton, L T Byars, Roth and Warren, Judd and Havens, and Robinson, Stephensen, and Padgett have reported additional cases A total of 20 cases have been reviewed by us

In most instances, the denuded areas have been covered with granulation tissue before replacement of cover was attempted Various methods of secondary reconstruction of the scrotal sac and penile covering have been discussed previously by several of the above named group On the basis of our experience and that of other authors, we are presenting certain important considerations in dealing with this injury

Essentially the same conditions of trauma are found in most cases of total avulsion of skin from the penis and scrotum The integumentary covering is stripped cleanly from the shaft of the penis extending to the coronal margin of the glans penis, and from the scrotal sac, with or without complete avulsion of the penis or testicles The anatomical nature of these structures is such that the skin peels cleanly off the underlying fasciae because of its specialized nature No attempt will be made to discuss reconstruction of deeper injury such as laceration of the urethra or corpora of the penis

To discuss briefly the anatomical considerations The integument of the penis is thin, free of subjacent fat, with few hairs or sebaceous glands It lies directly over the fascia penis The dartos is very poorly developed under the penile skin The integument of the scrotum has many glands and scattered hairs It has numerous ridges, is extremely loose, and in the deeper layers contains the dartos, which is a thin layer of smooth muscle fibers These muscle fibers are arranged at right angles to the skin creases Beneath the dartos is the intercolumnar fascia, and beneath this lies the cremasteric fascia and muscle This specialized structure has the important function of thermoregulation for the

* Presented in part before the American Society of Plastic and Reconstructive Surgery Oct 23, 1947, San Francisco Calif

testicles. The normal scrotal temperature is from one to three degrees Centigrade lower than normal abdominal temperature. The effect of abdominal temperatures on testicular function is well established. Prolonged temperature above the normal scrotal heat causes atrophy of the spermatogenic cells and resulting diminution of viable spermatozoa. This may cause complete sterility. Prolonged cryptorchidism is a clinical manifestation of this situation.

In replacing cover to the penis the only logical choice would be that of skin resembling the normal integument. Relatively hairless, thick split-thickness skin such as that taken from the abdominal wall would seem most desirable. Rotated flaps from the abdomen or thigh, as has been suggested by others as covering for the penis, or the use of scrotal skin are usually unnecessary and are not physiological. In addition, these procedures entail a series of operations and do not provide the best type of covering for the penis.

Split-thickness skin would resemble the normal covering in thickness and texture, it would contain no fat and lie directly on the fascia penis. Temporarily, after healing, this skin is tight around the penile shaft and constricts erection in length and circumference, but assumes almost normal stretch after the scar tissue beneath the skin graft softens. In the case of difficult erection due to excessive tightness of the skin, tunnel grafts could be applied as suggested by Robinson, Stephensen and Padgett.

Normally, split-thickness skin grafts tend to contract in their new site with the formation of scar tissue beneath the graft. This contraction is progressive for many months unless some type of stretch mechanism works to prevent this. Here we are dealing with an individual situation where the skin is stretched frequently and not permitted to contract in a fixed position. Also, the skin is not placed on granulation tissue which later forms contracting scar tissue. It is placed directly on the fascia with resulting less scarring beneath. We found one case on record where multiple small thick grafts (pinch grafts) yielded a functional, freely erectile penis after the process of scar softening had taken place. In suturing the skin graft over the penis one must avoid any straight full length scars. These will restrict erection and may cause the penis to curl. The well established principle of "breaking up" a straight scar over any movable surface must be adhered to. This type of scar may be avoided by zig-zagging the edges of the grafts where they are sutured together. Thus a longer scar is produced which could elongate further with erection.

The criteria governing indications for reconstruction of a coverage for the testicles are: (1) adequate cover to the spermatic cords and testicles without undue tension or constriction, (2) proper protection of the scrotal contents against trauma, and (3) comfort of the patient in any position or activity. To suspect that one could reconstruct a normal thermoregulatory sac is pure folly. Certainly flaps rotated from the thigh or abdominal wall would not offer this. The thickness of these flaps, their relative rigidity and the unspecialized nature of the skin could not replace the function of the dartos and normal scrotal skin. Consequently, one must be content to be governed by the above criteria in considering reconstruction of covering. This is best accomplished by imbedding

FIG 1. CASE 1. PATIENT 60 YEARS OLD PICTURES TAKEN 36 HOURS AFTER THE INJURY

the testicles and spermatic cords in the most adjacent regions of the upper thighs. The optimum position is the medial upper thigh region as far posterior as the length of the spermatic cords permit. In an anterior position the spermatic

FIG. 2. CASE 1. PICTURES TAKEN AT OPERATION

(a) Upper left. The skin graft has been sutured to the pubic margin of the defect.
(b) Upper right. Full exposure of the perineal aspect of the denudation.
(c) Middle left. The skin graft has been carried around the entire shaft of the penis and base of the spermatic cords. Straight line scar is avoided over the ventral aspect of the penis by zig-zagging.
(d) Middle right. The testicles have been drawn into the thigh pockets with heavy silk traction sutures placed through the lower pole of the tunica vaginalis.
(e) Lower left. The penis is drawn downward to show the skin graft tacked into place around the base of the penis.
(f) Lower right. Completed operation. The traction sutures have been tied loosely around gauze bolsters and Penrose drains inserted into the testicular pockets. Note that the left testicle has been drawn down lower than the right. This was done to avoid direct apposition of the testicles with the thighs together.

cords may be placed under undue tension when the thighs are spread apart This depends on the length of the cords in the individual If the testicles are imbedded at staggered levels in the medial thighs, they will not oppose each other with the thighs together

In the cases presented here and those presented by others, the patients have been perfectly comfortable with the testicles imbedded in these types of pockets Usually they have refused any further procedures to reconstruct a deeper scrotal

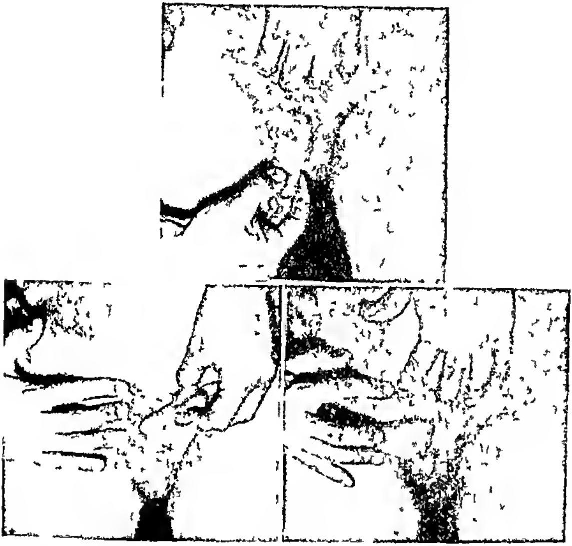

FIG 3 CASE 1 PICTURES TAKEN TEN WEEKS POST OPERATIVE

The skin over the dorsum of the penis is quite loose but the base of the ventral aspect is still somewhat tight along the suture lines Apparently the weight of the testicles has stretched the perineal skin enough to form a shallow scrotal sac

sac As stated above, it is wishful thinking to suppose that a thermoregulatory organ can be constructed when the scrotal skin has been completely avulsed

The two cases here were repaired within a relatively short time following the injury, without waiting for the formation of granulations, or the use of trouble some skin flaps The procedures used were expedient and produced good functional results with a minimal convalescent period We feel that the principles mentioned above have sound anatomical and physiological basis with maximal benefits

ISCHEMIC CONTRACTURE, LOCAL, IN THE HAND

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An interesting entity newly recognized in the hand is fibrous contracture of its intrinsic muscles that is quite similar in pathology to Volkmann's ischemic contracture in the forearm. Resulting in typical deformity, it is easily recognized by a few simple tests. It is disabling but can be improved by surgery.

INCIDENCE

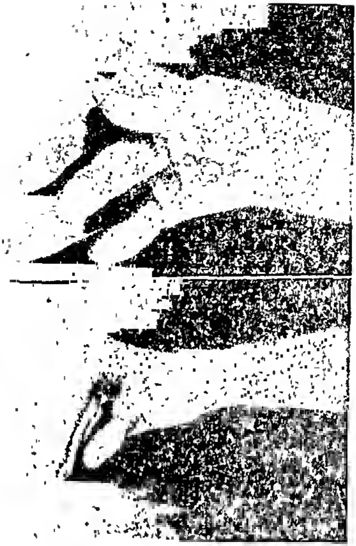
In the great concentration of crippled hands during the last war, several score of such cases were encountered by the senior author. Now, two years later, the left-over dregs, or tough hand cases in the Army, are being seen and it is found that among them this entity is very common.

ETIOLOGY

Many give the history of injury to arm or hand followed by application of a plaster cast well down over the fingers and often clumping the thumb into the hand. The resulting swelling of the hand in the unyielding cast so expressed the blood supply that the intrinsic muscles of the hand underwent fibrous degeneration and contracture and also, to a lesser extent, the other tissues in the hand.

Many other cases give the history of injury to the brachial plexus or large arm nerves followed by application of a plaster cast including the hand. A good proportion of these had injury to the axillary and brachial arteries, and the pulse at examination was small or absent. Some had lost both radial and ulnar arteries from an explosion wound at the wrist. Another was from a severe cut through these two arteries high in the forearm. Some were burn cases, the muscles having been rendered ischemic from a too constricting pressure dressing. Though most limbs had swelled in casts, some of those with injury had not been enclosed in casts, the tight swelling and poor nutrition of the hand producing the same result.

The same phenomenon occurred in all due to lessened circulation. There resulted fibrous degeneration and contracture, especially of the intrinsic muscles of the hand, and tissue changes and poor nutrition throughout the hand. Any one or several intrinsic muscles may show fibrous contracture due to local injury such as gunshot wound, pressure or burn. Though entirely different in etiology, due to cicatrix and adhesions they give the same test as does the muscle that has been contracted from ischemia. From a burn on the dorsum of the hand it is common to find the extensor mechanism adherent and the underlying interossei



Needs deep
read the first
two metacarpals. (Courtesy of L. D. Howard, Jr., Lt. Col., M.C., Wakeman General Hospital.)

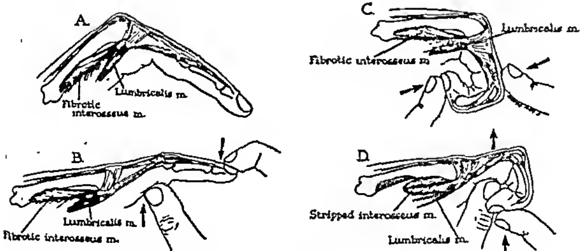
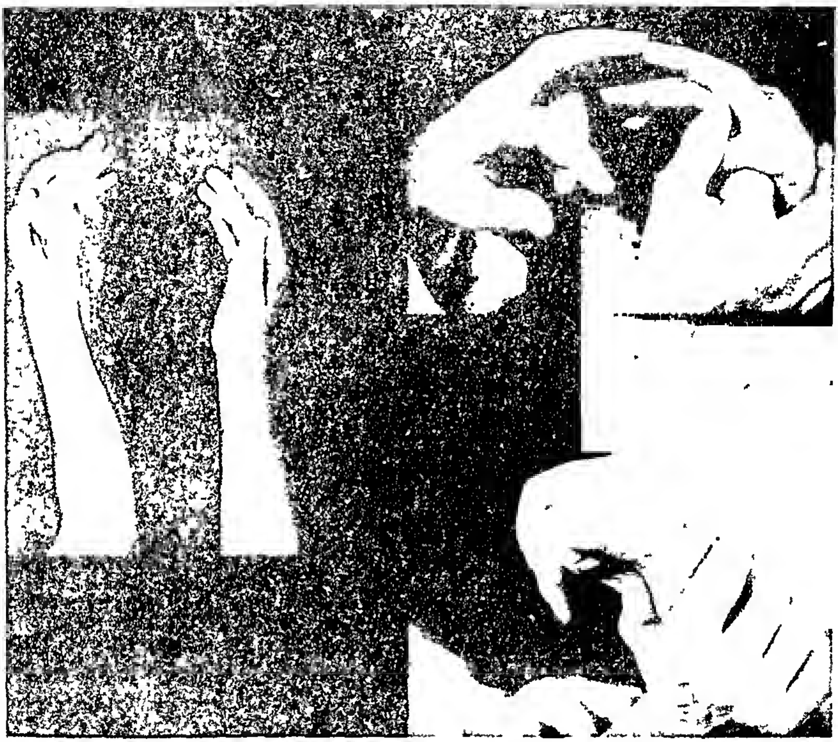


FIG. 2A. 'Intrinsic plus' position with fibrotic intrinsic muscles holding the proximal

contracted thus tying the function of each. In rheumatic deformities of the intrinsic plus position there is contracture of the intrinsic muscles.

Commonly a similar condition from ischemia may be seen in the foot from a tight cast or injury of a main artery in the leg. An example is of a soldier shot two years ago at the groin through the femoral artery and sciatic nerve. The foot showed dorsal pigmentation and an ulcer from poor circulation, and another ulcer was present under the fourth metacarpal. The toes showed the same test



A

B

C

FIG. 3A. Following fracture of both bones of the forearm and swelling limited by cast, generalized ischemic contracture developed.

B and C. Ring finger being tested shows signs of contracture of its intrinsic muscles. When proximal joint is held in extension, the distal two joints cannot be flexed, but they flex easily when the proximal joint is flexed.

of muscle imbalance from contracture as explained later for the hand and assumed the same position with proximal joint flexed and distal two joints extended. Another was in a soldier in which both popliteal nerves and the artery were injured.

SYMPTOMS

The deformity, or position of muscle imbalance, directs the attention toward the diagnosis. In intrinsic paralysis there is claw-hand, flat-hand, and the thumb

is at the side. In intrinsic spasm, or contracture, on the other hand, the thumb is straight, is clumped into the hand, and the fingers are straight in their distal two joints but flexed in their proximal joints. The palmar arch is exaggerated. The first of these positions from imbalance may be called intrinsic minus, and the second intrinsic plus. In the entity described the position is that of intrinsic plus as the intrinsic muscles are in fibrous contracture. The position assumed is somewhat like that of a hand about to enter the sleeve of a coat.

The thumb is held straight but drawn into the palm near the second and third

A

B

C

D

FIG. 4. (Case N. D.) Following fracture of radius and ulna and swelling in a cast, both Volkmann's ischemic contracture and ischemic contracture, local in the hand, were present.
A and B. Fingers are flexed at their bases and the thumb is drawn toward the third metacarpal.
C and D. Showing test for contracture of intrinsic muscles. When the proximal joint is extended, the distal two will not flex, but they will when the former is flexed.

metacarpals. The angle between the first two metacarpals is narrowed because of the cicatrix between them and the adductors and first interosseus muscles which have contracted due to scar. From the contracture in the cleft the carpometacarpal joint may become hyperextended instead of flexed.

The fingers are drawn by the cords of the fibrous muscles, lumbricals, and interossei into flexion in their proximal joints and extension in their distal two. Exaggeration of the metacarpal arch causes the fingers to converge.

There are to be seen hollows from atrophy just as in combined median and

ulnar palsy as the interossei, thenar, and hypothenar muscles have atrophied in fibrous contracture. With this atrophy the appearance is that of palsy of the intrinsic muscles though the deformity is opposite. The whole hand is poor in nutrition as its blood supply had been squeezed out from swelling in the cast, or because of interruption of the blood vessels of the arm nutrition was lowered. All tissues were affected though the muscles more so. The fibrous change is irreversible. The hand when grasped feels firm and stiff. The pulse is present

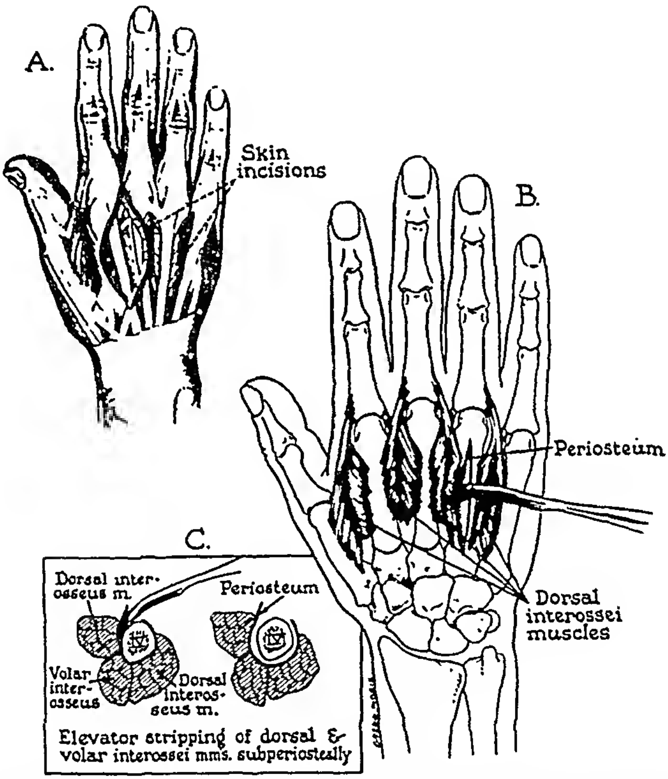


FIG. 5. Illustrating operation of stripping and advancing interosseus muscles to allow extension of the proximal finger joints and flexion of the distal two joints.
A. Two incisions.
B. Muscles freed from bones and advanced enough to allow full motion.
C. Curved separator used to detach muscles from metacarpals.

except in those cases in which there was interruption of the main artery of the limb in which case it is weak or absent.

Some of the thenar or intrinsic muscles may be affected more than others. Thus, we may feel in one thenar eminence the adductors reduced to a palpable fibrous band and in another the flexors or the abductor or opponens muscles. In one case a lumbrical only was involved.

There is every degree of involvement grading from extreme cases to mild ones

which show the condition in only a few digits In severe cases the muscles are reduced to fibrous cords and no longer have active contraction In milder ones the muscle is fibrous and shortened but still has considerable voluntary action This may be determined by feeling the lateral bands as the distal finger joints

A

B

F . . .

M C , Dibble General Hospital)

are moved and by observing the ability to voluntarily extend the distal two finger joints without using the long extensor

Test for contracture of intrinsic muscles to fingers If we tense the interossei by holding the proximal joint in extension, the distal two joints cannot be passively or voluntarily flexed But if we slacken the interossei by flexing the proximal joints, the distal two joints flex readily The examiner strains the

proximal finger joint firmly in hyperextension thus tensing the interossei. Then tapping on the finger nail meets with firm resistance, the distal two finger joints standing out stiff and straight.

This is similar to the test for fixation by adhesions of a long extensor tendon on the dorsum of the hand, but in the latter case when we hold the proximal joint on a strain in flexion, we cannot force the distal joints into flexion. When the proximal joint is allowed to extend, the distal two joints flex freely. The extensor tendon may be adherent and the interosseus muscles contracted in the

A

B

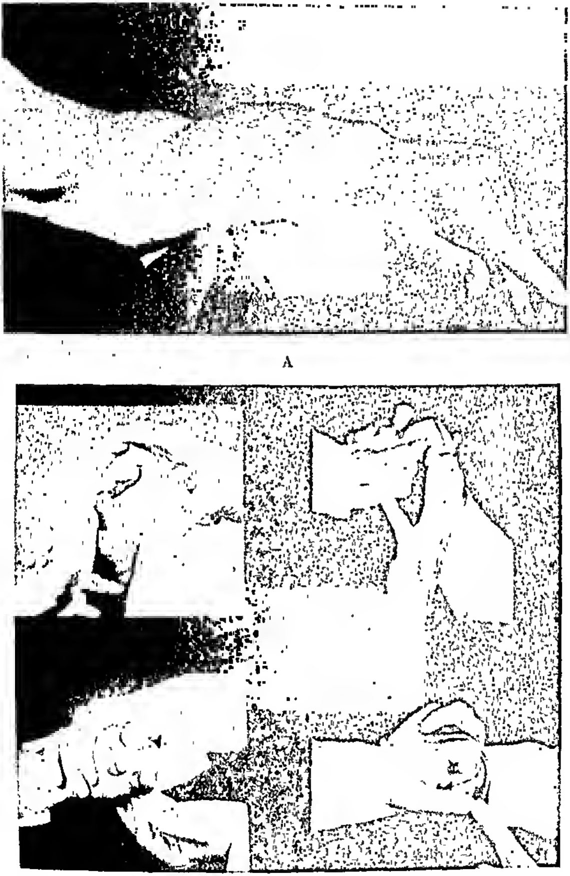
C

FIG. 7. Showing not ischemic contracture but merely the result of adhesion of the interosseus muscle and extensor tendon to metacarpal which has been shattered.
A. Test shows that the interosseus muscle is adherent.
B. Test shows the long extensor tendon to be adherent.
C. After the long extensor has been freed and the interosseus muscle advanced by stripping, mobility of the finger is increased.

same hand thus responding to both tests. Even flexion adhesions in the palm may complicate the picture. A similar but reverse test discloses this.

Contracture of thenar muscles is determined by the inability to draw out the thumb into abduction or opposition, atrophy of the thenar eminence, and a feeling of firmness with palpable fibrous bands in the thenar muscles. There is little or no voluntary action of the base of the thumb.

These hands have little function. Neither the fingers nor the thumb may open for grasp, skill is lost, and there is, in general, poor nutrition. The hand



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owing typical position due to effects
earm.
scles to fingers
on the interosseus muscles.
pping adductors of thumb.

cannot assume the position of function. The intrinsic plus condition is as crippling as that of the intrinsic minus.

TREATMENT

If it is recognized early that the condition is impending, it may be prophylactic to slit open the fascial covering of each intrinsic muscle. Only in a mild case

A C

B D

FIG. 9. Ischemic contracture of the intrinsic muscle in the hand due to impaired circulation following fractures from shell fragments of shoulder, forearm, and wrist.
A. Thumb in adduction contracture and fingers in typical position produced by contracture of the interosseus muscles.
B. When the proximal finger joint is extended, the distal two cannot be flexed.
C. When the proximal finger joint is flexed, the distal two joints will flex.
D. Postoperatively after the thumb cleft was opened by a plastic maneuver, and the interosseus muscles were stripped, the fingers could then flex while their proximal joints were held extended, and the thumb cleft was wide.

can position be improved by splinting. It is necessary to either excise or sever the fibrous contracted muscles, or if they are still active, to strip them to displace their bellies distalward or elongate their tendons. Our aim should be to achieve the position of function and give as much motion as possible from this position in both extension and flexion.

Thumb. Here the problem is to open the angle between the first two metacarpals, to maintain it so, either with or without motion, and to furnish sufficient skin for a wide cleft.

Through a dorsal incision bisecting the cleft and usually carried across the web to parallel the thenar crease, all fibrous contracting tissue and inactive parts of the thenar muscles are excised If the adductors are active but too short, the tension may be relieved by pushing off with the handle of a scalpel their origin from the third metacarpal Even part of the capsule of the carpometacarpal joint of the thumb may need cutting to allow full abduction and opposition of the thumb One should guard against wounding the radial artery deep in the cleft.

The thumb will again draw into the palm and toward the second and third metacarpals unless guarded against by a pulley transfer operation for opposition, a temporary transfixion at a wide angle of the metacarpals of the cleft by cross pinning them with Kirschner wires, or by holding the thumb in moderate abduction and opposition permanently by a bone block in the angle or a cross bone graft

The defect in skin is then closed by a flap of skin from the abdomen in one procedure tubing the base of the flap After three weeks it is detached from the abdomen. A thick split skin graft may be used instead but it will be less satisfactory

Fingers. In the fingers correction of deformity and imbalance is done either saving the remaining function of the interosseus muscles or discarding any hope for this Decision depends on whether the interosseus muscles are active or are entirely reduced to scar

If the muscles are active though shortened, a stripping operation is done through two longitudinal dorsal incisions, two through each The muscles are freed from the bones and allowed to displace distalwards The fingers, now free from restraint, are put up in moderate claw position for about two weeks It is also possible to lengthen the tendon of the interosseus muscle by cutting through it long and obliquely and resuturing

Should the contracted muscles be no longer active, a tenotomy may be done on the tendon to the lateral band on the side of the finger opposite the proximal finger joint wherever needed This, theoretically, would cause clawing but practically there is a tendency for the contracture to recur If clawing should occur later, the sublimis tendon may be transferred to the lateral band or the MP joint fused in flexion.

By the above measures, both the position of function and improved function can be obtained. There will, of course, be a residue of fibrosis in the hand which will gradually improve with use.

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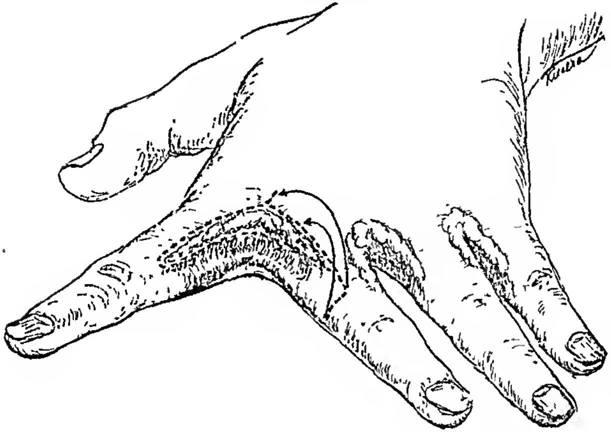

Fig. 1

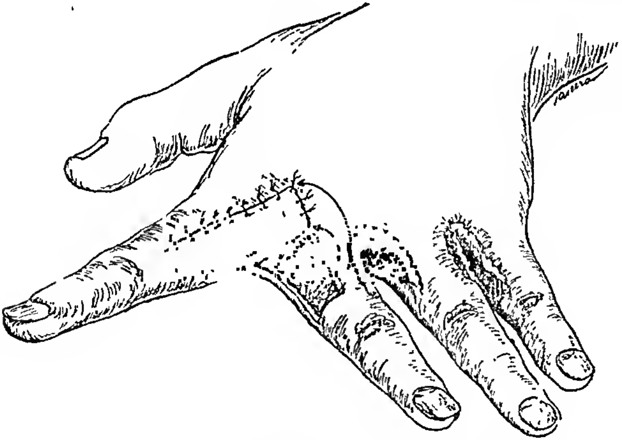

Fig. 2

Figs. 1, 2, and 3 Method of Replacement of an Interdigital Contracture by a Rotated Pedicle Flap from the Side of an Adjacent Finger, Combined with a Free Graft

a free graft applied to the dorsum of the hand, with extensions onto the fingers as needed, and trimmed to fit accurately the margins of the rotated flap.

A typical repair is illustrated by the case of a 34 year old soldier who was burned in a buzz bomb explosion in London in 1944. An examination of the

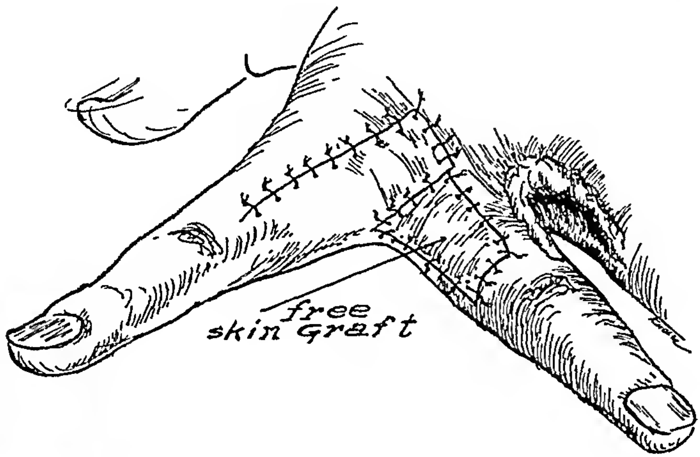

Fig. 3

Fig. 4. Preoperative Photograph of Case Described in Text

patient five months later disclosed thickened plaques of scar tissue on the dorsum of both hands, extending onto the fingers and forming tight bands across five of the interdigital webs. Stable free grafts covered part of both index fingers and the middle finger of the left hand (Fig. 4).

Fig 5

Fig. 6

Figs. 5 and 6. Two Years Post-operative Photographs of Case Described in Text

The correction was carried out in two stages. In the case of the left hand, normal interdigital webs were restored by excising the tenting scar bands and rotating flaps from the radial sides of the middle, ring and little fingers into dorsal position. The rectangular defects on the phalanges were covered with full thickness grafts.

A slight modification of the procedure was carried out on the right hand. All scar tissue on the dorsum of the hand and proximal phalanges of the index, middle and ring fingers was excised and pedicle flaps from the sides of the index and ring fingers were rotated into dorsal position and sutured to dorsal hand skin, thus reconstructing the interdigital webs. The defects on the dorsum and side of each involved finger were covered with patterned full thickness grafts taken from the abdominal wall (Figs. 5 & 6).

SUMMARY

A method of correcting an interdigital burn contracture by the use of a rotated pedicle flap from the side of an adjacent digit is presented.

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REPAIR OF CICATRICIAL AND DUPUYTREN'S CONTRACTURES OF THE HAND*

HANS MAY, M D

Philadelphia, Pa

The common causes of cicatricial contractures of the hand are shrinkage of the skin and fascial structures from prolonged and rigid immobilization of the hand in faulty position after injuries, infections and burns The vast majority of these contractures could be avoided if the hand were immobilized in a position of function When the wrist is held in flexion, that means in wrist drop, and allowed to remain in this position, the extensor tendons are maximally stretched, hence, cannot be relaxed further if an attempt is made to close the hand to make a fist This prevents the flexor tendons from fully functioning It draws the fingers in hyperextension in the metacarpophalangeal joints, and draws the thumb back into the side of the hand In this position the collateral ligaments of the metacarpophalangeal joints are relaxed and shortened Prolonged immobilization in hyperextension of the fingers causes a rapid shrinkage of the collateral ligaments, which prevents a normal gliding of the phalangeal joint surface over the head of the metacarpal bone It also causes a contracture of the posterior part of the joint capsule It increases the pull of the flexor tendons causing a flexion of the interphalangeal joints In this position the normal action of the lumbricalc system is upset The lumbricales flex the first phalanx in the metacarpophalangeal joint and extend the last two phalanges When the antagonists of these two muscles are contracted, i e , the finger hyperextended in metacarpophalangeal joint, the lumbricales are in position of relaxation and contract in this position adding to the hyperextension of the first phalanx and partial flexion of the last two phalanges This is the well known picture of the claw hand (Fig 2) Such a contracture can readily be prevented by immobilizing the hand in position of function, namely, extension or cocked up position of wrist, and flexion of the metacarpophalangeal and interphalangeal joints, and abduction and opposition of the thumb If contractures have developed, the latter should be overcome first by conservative methods in the form of elastic splinting with incorporation of elastic traction in association with occupational and physical therapy, or by operative reconstruction The latter is quite often necessary in cicatricial contractures from burns These burn contractures present some of the most difficult problems of reconstructive surgery The difficulty mounts with the depths of the scar while in other parts of the body a second degree burn as a rule does not cause any functional damage since epithelium regenerates from the remaining layer of the cutis at the hand, however, particularly at the dorsum second degree burns quite frequently are followed by severe contractures from keloid like scars The scar contracture of the skin, however, is the lesser evil Much more disastrous are the contractures of the

* Presented before the Philadelphia Academy of Surgery Jan 5 1948

deeper structures, namely, of fascia, ligaments, and tendons. Many of th contractures could have been avoided if the hand were probably immobili during the healing stage, and skin grafting employed early. This is particul true in third degree burns.

FIG 1 CASE OF IMMOBILIZATION OF HAND AND FINGERS AFTER RELEASE OF PALMAR CICATRICIAL CONTRACTURE

The contracting scar was excised denuding the palmar and volar surface of the fing The contracted tendons were stretched without opening the tendon sheath The hand placed on a sterile well-padded wooden splint Forearm and wrists were bandaged to splint Wire traction was applied through the bone of each finger The wires were tened to the ends of the splint keeping the fingers in extension and abduction The thu was held against a bandage roll in abduction The raw surface was then covered wit thick split skin graft The photograph depicts the hand ten days after the operation, a removal of the first dressing and of the sutures Graft took well

The principle in correcting these contractures consists of excision of the ent cicatricial surface tissue followed by repair of the contracted fascial structu and closure of the defect with a graft or flap. Nowadays with improved tech of skin grafting, grafts can more often be used than has been thought possi

heretofore A free graft, however, will not take on naked tendons, bones, or joints Hence, every effort should be made not to expose these structures, which is possible in many cases by procedures as outlined later on

The operation is carried out under general anesthesia with a pneumatic tourniquet applied, which is inflated to 250 millimeters This pressure is maintained throughout the first part of the operation until the scar is excised The blood pressure cuff is then deflated to give the surgeon an opportunity to ligate the bleeders After hemostasis is completed the arm is elevated for three minutes and the blood pressure cuff pumped again to 250 mm of mercury and remains applied until the pressure dressing is applied The entire scar is outlined with an incision—the depth of the incision depends upon the depth of the scar tissue In a second degree burn the excision of the cicatricial skin is carried in level of the subcutaneous veins Care should be taken not to injure them In third degree burns in which the superficial fascia is destroyed and replaced by scar tissue, excision of the scar tissue is done in level of the deep structures But care should be taken not to expose the tendons if the use of a free skin graft is considered In the majority of cases, exposure of the tendons can be avoided by removing the scar tissue over the tendons in layers, and stretching of the tendon is gradually done by cross cutting the covering tissue in numerous places until full or almost full relaxation of the tendons can be reached The blood pressure cuff is now deflated, followed by thorough hemostasis Forearm and hand are now immobilized In contractures of the palm, the fingers are extended and forearm and hand are placed on a sterile well padded splint In some cases the fingers can be kept in extension readily by bandaging them In some cases wires should be passed through the terminal phalanges and the wires fastened to the end of the splint (Fig 1) In contractures of the dorsum of the hand and the fingers, the collateral ligaments of the metacarpophalangeal joints, if contracted, fix the metacarpophalangeal joints in hyperextension It is most difficult to overcome such a contracture just by simple stretching Invariably the collateral ligaments must be severed from their insertion at the heads of the metacarpals, great care must be taken not to injure the digital vessels while doing this The forearm and hand are placed on a sterile well fitted wire mesh or aluminum splint The splint is bent until the fingers are in 45° flexion in all joints The wrist is slightly extended The defect is now covered either with a full thickness graft or with a thick split graft If properly removed and applied, either one will give equally good results (Fig 2) If, however, tendons are exposed (Fig 3), or must be replaced (Fig 4), the use of a pedicle flap is the only choice If a graft is used, the graft is sutured in place with a continuous suture of fine silk A heavily padded pressure dressing is then applied Dressings and sutures are removed eight days after the operation The splint remains in place for another six days Warm saline hand baths are administered daily with active and passive motion exercises while the hand is in water The splint is reapplied after the exercises, and then discarded entirely three weeks after the operation An extensive motion exercise program is then outlined for the patient

Dupuytren's Contracture of the Palmar Aponeurosis This condition must be

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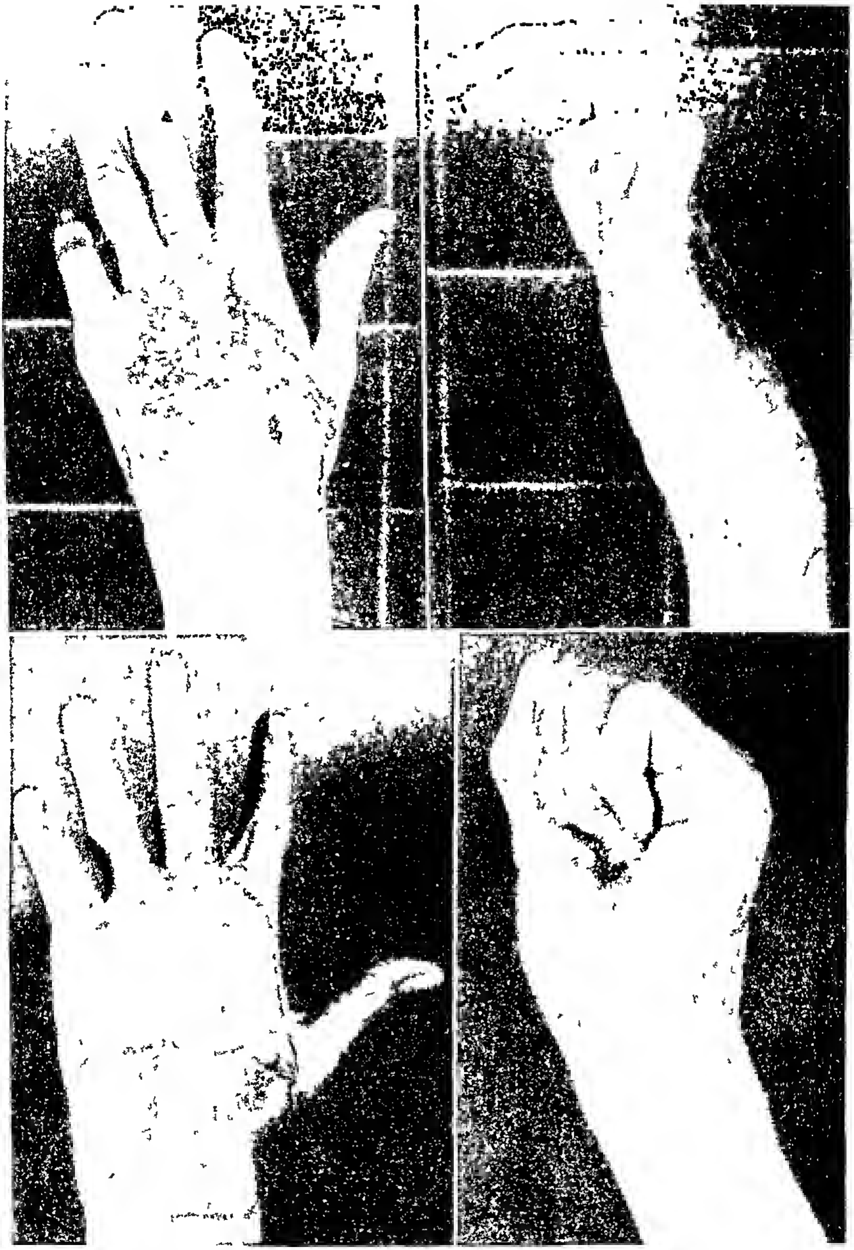


FIG. 2A. CONTRACTING KELOID SCAR OF DORSUM OF HAND AFTER SECOND DEGREE BURN

FIG 2B MARKED LIMITATION OF FLEXION
Hyperextension deformity of metacarpophalangeal joints and claw-hand deformity.

FIG 2C, D EXCISION OF SCAR TISSUE AT LEVEL OF SUBCUTANEOUS VEINS
Reduction of contracture after gradual stretching Severance of collateral ligaments at metacarpophalangeal joints of 5th finger, and application of thick split skin grafts. Six weeks after operation and extensive physio- and occupational therapy.

classed among diseases of unknown origin The disease progresses gradually, involving not only the palmar part of the aponeurosis but extension to the 4th and 5th fingers, less often those of the other fingers, vary rarely the thumb In many instances the disease is recognized late and operated inadequately It is impossible to restore motility of the fingers if the latter are arthritic and ankylosed

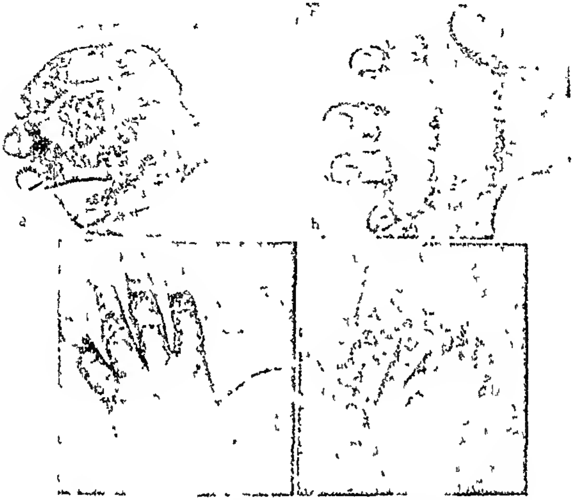


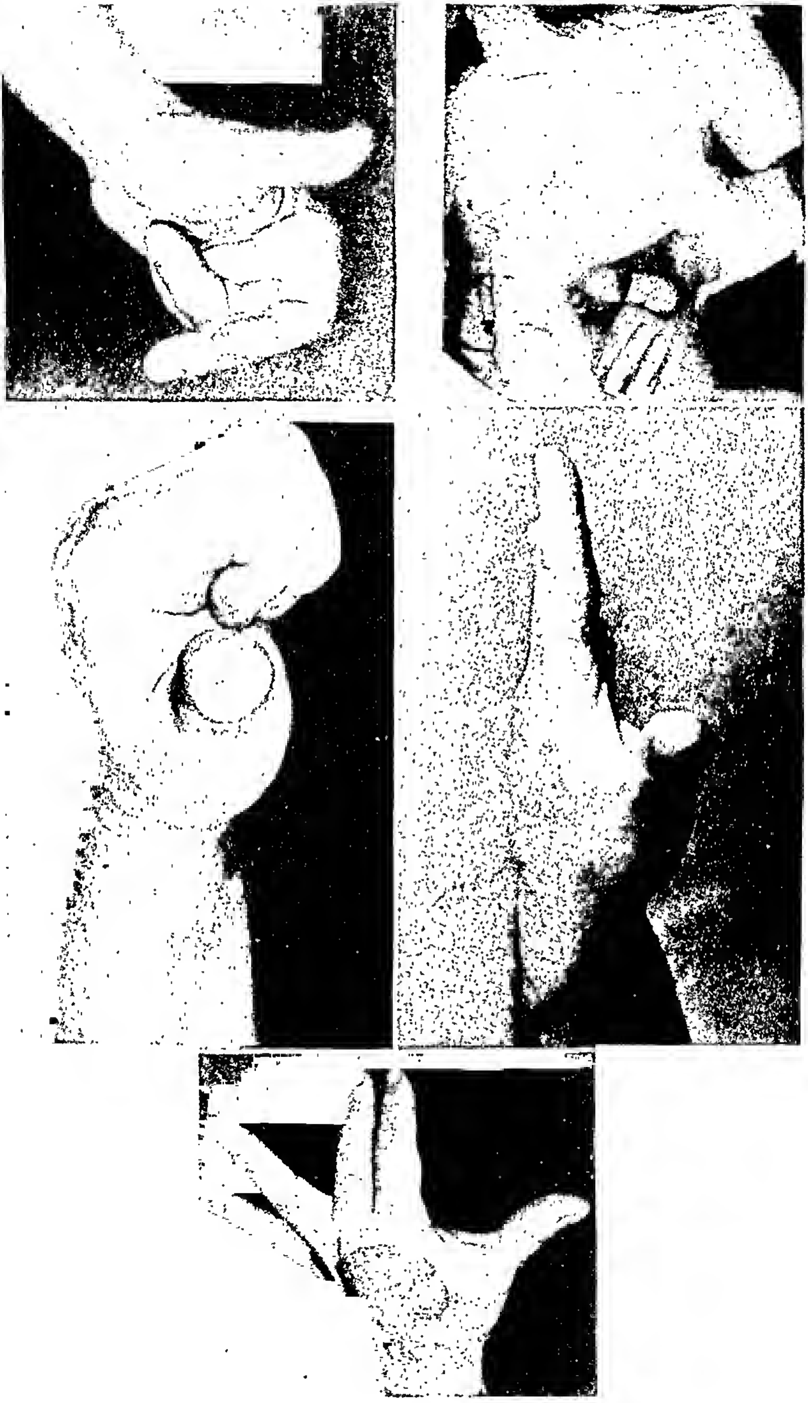
FIG 3A EXTENSIVE WRINGER INJURY WITH EXPOSURE OF TENDONS AND JOINT CAPSULES IN METACARPOPHALANGEAL AND INTERPHALANGEAL JOINTS

FIG 3B

[illegible] flap [illegible] after [illegible] the index finger, was severed The flap edges were sutured [illegible] finger Twelve days later all pedicles were severed with [illegible] along the ulnar surface of the fifth finger Two days lat[illegible] Four weeks later the skin bridges between the fingers were severed down to the webs of the fingers, and each flap was attached to the respective wound edge of the fingers

FIG 3C, D FUNCTIONAL RESULT SIX WEEKS AFTER THE FINAL OPERATION

Insufficient removal of the diseased structures invites recurrence The peculiar process is not only confined to the palmar fascia, although the latter is the primary site The nodules and the shrinkage of the skin over the diseased fascia, and the not infrequent recurrence of the contracture in the skin even after thorough removal of the underlying fascia, are definite proof of the above state-



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FIGS. 4A–E

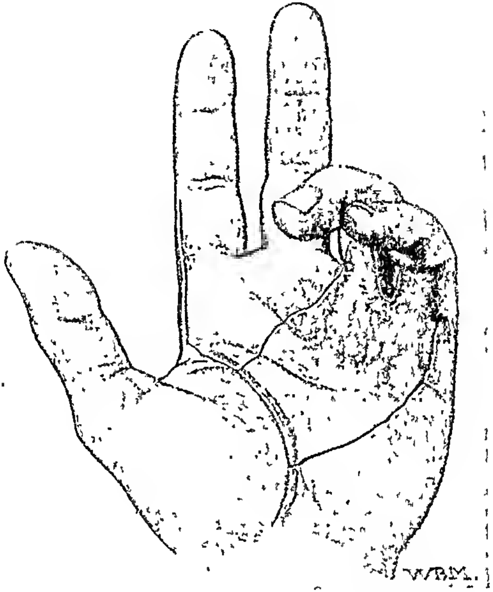

FIG 5A REPAIR OF DUPUYTREN'S CONTRACTURE OF THE PALMAR APONEUROSIS

weeks later the abdominal flap was mobilized The peripheral part of the flap became cyanotic, hence the flap was returned to its original site Six weeks later the scar at the dorsum of the hand was excised The abdominal flap was elevated, the flap bed skin

r cast applied One

tory clamp applied.

Note the inability

weeks in extension

ment. These findings invoked Lexer not only to remove the entire fascia, but also the involved skin. Macroscopic and microscopic examinations of removed specimens revealed clearly that the palmar fascia is intimately connected with skin and also with the underlying tendon and tendon sheath by dense fascial ex-

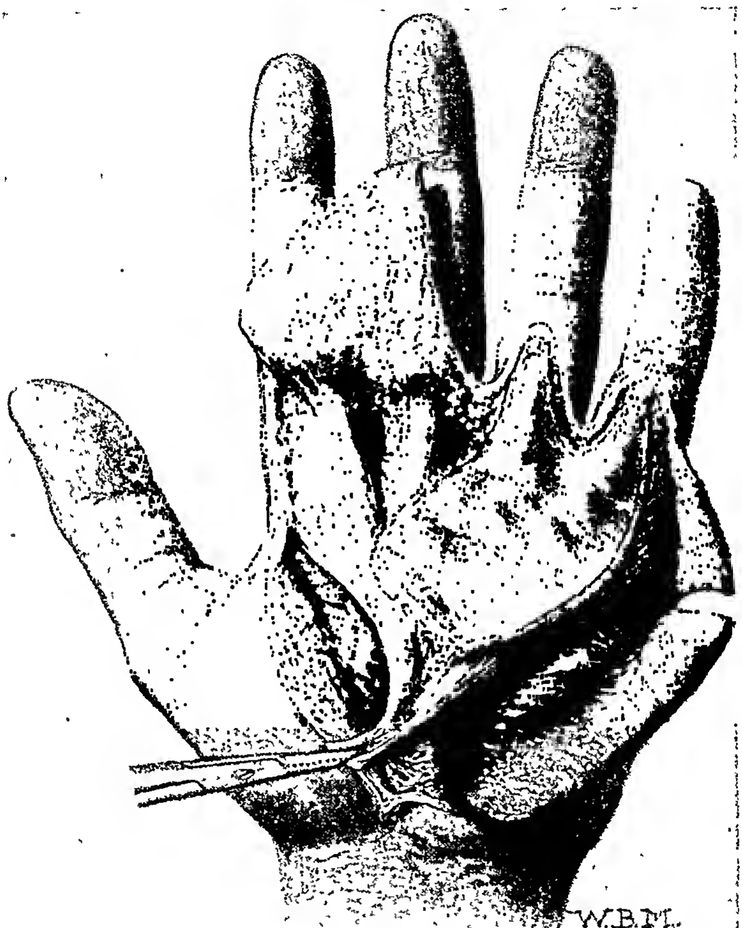

Fig. 5B. Skin and Subcutaneous Tissue of Thenar and Hypothenar Region Are Dissected Away from the Palmar Fascia
The same is done with the healthy skin of the radial and dorsal part of the palm. The three skin flaps are reflected exposing the entire palmar fascia and leaving the island-like diseased part of the skin in connection with the fascia. The dotted line indicates the distal lines of excision.

tensions. Only after complete removal of fascia and fascial extensions can recovery be expected with return of good function. The operation is tedious and should always be performed with a tourniquet applied.

Technic: The incision (after Lexer) starts over the origin of the palmar fascia (Figs. 5–7), proceeds along the main longitudinal palmar crease, crosses the trans-

verse creases at the radial side of the palm and ends over the radial side of the base of the index finger. The diseased part of the skin is now circumscribed by another incision, while a small transverse incision is added at the ulnar side to facilitate exposure. The skin and subcutaneous tissue of the thenar and hypothenar region are now dissected away from the palmar fascia. The same is

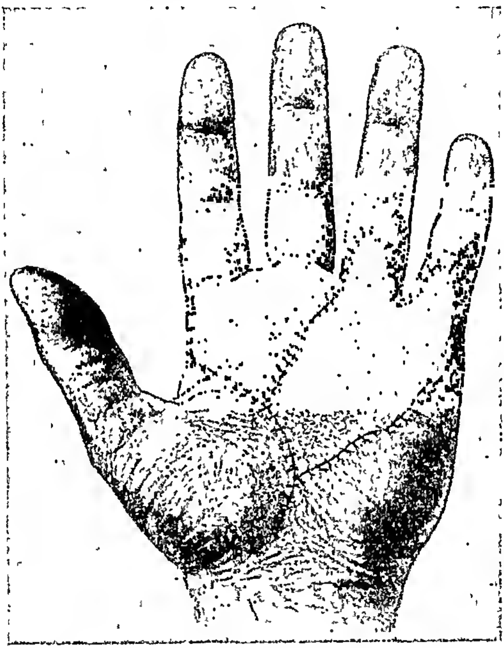

FIG. 5C. THE SKIN FLAPS ARE RETURNED AND THE DEFECTS COVERED WITH A FULL THICKNESS GRAFT

done with the healthy skin of the radial and distal part of the palm. Thus, three skin-subcutaneous tissue flaps are formed, which if lifted up expose the entire palmar fascia and leave the island-like diseased part of the skin in connection with the fascia.

The fascia is now severed from its tendon. Under constant vertical traction, the entire fascia is excised. The excision must be radical, i e., it must include

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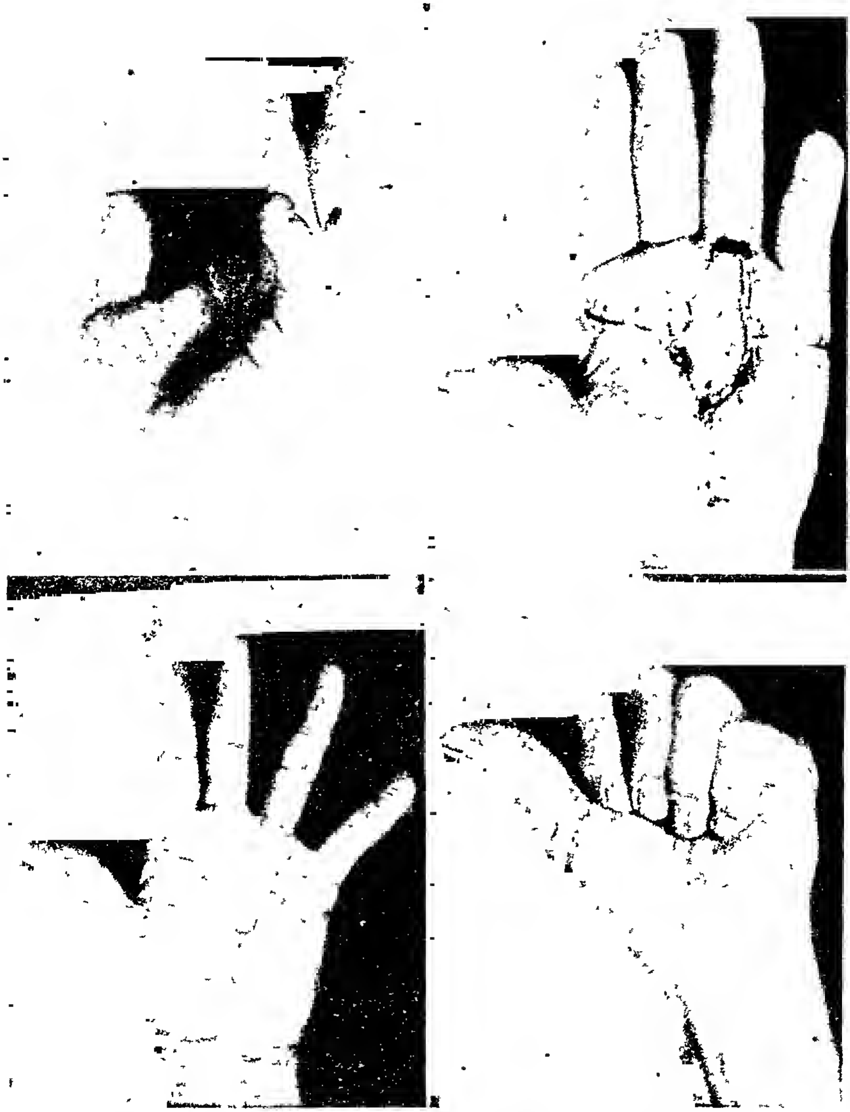


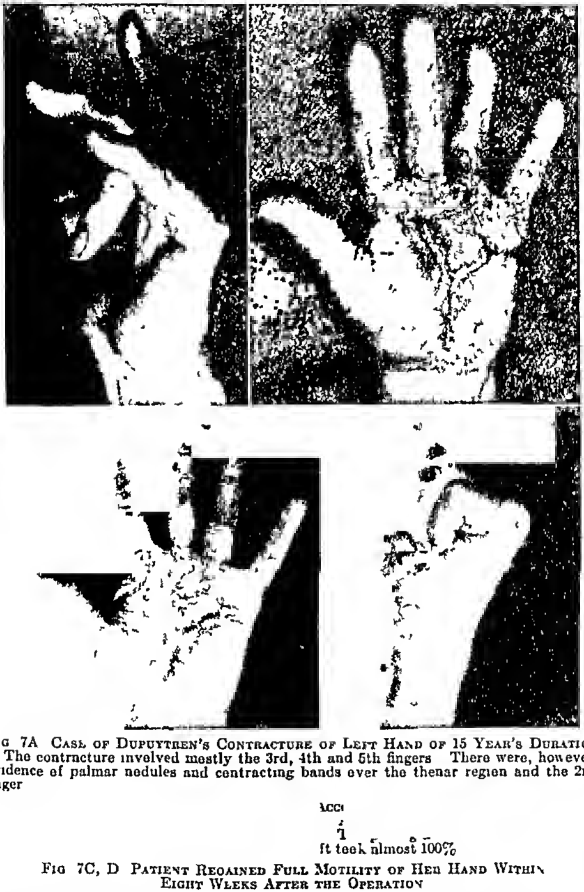
C D

Fig. 6A. Dupuytren's Contracture of Left Hand of Five Years' Duration

Fig. 6B. Repair of the Contracture According to the Method of Fig. 5
Immobilization of the hand for two weeks. Active motility in daily hand bath after that time.

Fig. 6C, D. Patient Regained Full Motility of His Fingers within Five Weeks

the fascial extension over the thenar region, the extension to the second, third, fourth, and fifth fingers; it must include the fascial extension, which connect the fascia with the underlying tendons and tendon sheaths, and also the diseased skin island. The dissection is tedious and should be carried out with great care

A  B

C D

FIG 7A CASE OF DUPUYTREN'S CONTRACTURE OF LEFT HAND OF 15 YEAR'S DURATION The contracture involved mostly the 3rd, 4th and 5th fingers There were, however, evidence of palmar nodules and contracting bands over the thenar region and the 2nd finger

ACC

1

It took almost 100%

FIG 7C, D PATIENT REGAINED FULL MOTILITY OF HER HAND WITHIN EIGHT WEEKS AFTER THE OPERATION

to avoid injury to the digital nerves and vessels The tendon sheaths should not be opened

The blood pressure cuff is now deflated Thorough hemostasis is the next

step. Forearm, hand and fingers are immobilized on a previously prepared, well-padded splint. The three skin flaps are returned. The defect left from excision of the diseased skin is covered with a thick split graft. The usual pressure dressing is now applied. The after treatment is similar to that described above. If the excision should have resulted in wide exposure of the tendons, closure of the defect with an abdominal flap becomes advisable, since a free graft will not survive on poorly vascularized structures, such as naked tendons.

SUMMARY

The consequences of improper immobilization leading to contractures of the hand after injuries, infections or burns are discussed. Then follows a discussion of the repair work of these contractures, and also a discussion of reconstructive surgery of Dupuytren's contractures of palmar aponeurosis.

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AN OPERATION TO AID IN THE FORMATION OF NEW NAIL BEDS*

BEVERLY DOUGLAS, M D

The development of a skin-covered scar in an injured nail bed may result in lack of adherence of the nail or in the impingement of its advancing edge against the scar, or both, with resultant pain and tenderness Such a case is reported below along with the procedure which resulted in complete relief of symptoms and restoration of the nail and its bed to a normal condition

CASE REPORT

Patient W C , a 24 year old male medical student at Vanderbilt University, sustained a contusion of his right thumb in an auto accident on December 9, 1946 A subungual hematoma formed and was drained by drilling a hole in the nail six hours after injury Three weeks later the nail was gradually separating from the bed when the thumb was again accidentally struck, tearing the old nail from its bed and leaving the new nail covering only the proximal third of the nail bed

During the next month, while the nail advanced an additional one third of the distance to the end of its bed, granulation occurred in the nail bed distal to it with subsequent scar formation By the end of the month the scar was completely blocking the distal advancement of the nail, and the latter had begun to buckle as its edge turned inward and cut into the flesh of the finger When examined by the surgeon at this time the patient complained of progressively more pain at rest and marked tenderness on pressure

During the next four weeks the condition gradually became aggravated, and hypertrophy of the tissues of the tip of the finger occurred as shown in Figure 1

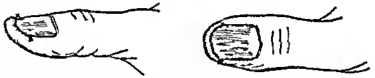

FIG 1 OPERATION FOR THE FORMATION OF NEW NAIL BEDS

Before operation fleshy blockage to growth of nail causing pressure on dorsal ridge of skin and subcutaneous tissue along shaded curved line x x, with resultant pain and tenderness

First operation March 16, 1947 Insertion and fixation of artificial celluloid nail under a double pedicled flap, and over the growing nail Figure 2 shows the technic which was followed

Second Operation April 18, 1947 Excision of pedicled flap The knife point was inserted between the artificial nail and the flap and the lateral attachments or pedicles each divided fairly close to the thumb so as to allow the skin of the pedicles to fall over the two wounds of excision Details of this procedure are shown in Figure 3, which also contains a cross section diagram showing the relative positions of the pedicled flap, the artificial nail and the newly advancing nail Both operations were performed under local infiltration analgesia

Figure 4 displays a drawing of the thumb after the flap had been excised and shows the normal advancement and adherence of the nail to its bed

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* From the Department of Surgery Vanderbilt University Read by title at the Sixteenth Annual Meeting of the American Society of Plastic and Reconstructive Surgery, San Francisco, Calif , October 21, 1947

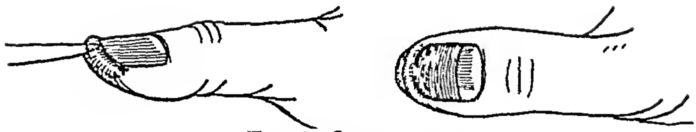

FIG. 2. OPERATION

Artificial nail inserted under double pedicled flap formed by undercutting flesh from tip of thumb exactly to distal edge of growing nail.

Artificial nail fixed by its under surface to outer surface of growing nail with colloidion. Edge of artificial nail allowed to project slightly distal to pedicle flap.

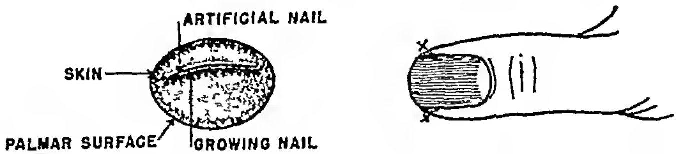

FIG. 3. (Left.) Cross section of finger through proximal half of flap. (Right.) Flap excised at x x. Artificial nail removed.

FIG. 4. FINAL RESULT

Flap previously excised at lateral pedicles and artificial nail removed. Nail has grown out with normal adherence to bed.

FIG. 5. FINAL RESULT

Photograph 10 months after operation. Arrows point to slight scars at sites of excision of pedicles of flaps on treated thumb.

In Figure 5 a photograph of the two thumbs is shown This was taken six months after operation Arrows indicate the slight scars on the treated thumb at the sites of excision of the pedicles of the flap The nail is normal in its rate of growth and its relation to the bed

A few points should be noted in reference to the operation and aftercare In the formation of the double pedicled flap the incision through the tip of the thumb, or finger, should be arched in order to follow the dorsal curve of the finger so as not to make the center of the flap too thick Artificial celluloid nails may be obtained at most ten cent stores in assorted sizes and a proper one chosen and trimmed to fit Flexible collodion will serve well to glue the upper surface of the growing nail to the under surface of the artificial nail After drying, fixation of the two surfaces will be favored by placing elastic adhesive strips snugly over the artificial nail and around the finger as far distal ward as, but not over, the pedicle flap A tongue blade splint on the palmar surface projecting one half inch beyond the tip of the thumb will greatly protect the part The artificial nail should be left in place until the new nail may be seen to have grown out under the artificial to a point beyond the distal edge of the pedicle flap The time this usually takes is about five weeks The flap is then excised and the artificial nail removed

It seems probable that two definite objectives are accomplished by this simple operative procedure The first of these is to make a direct subcutaneous arched tunnel from the tip of the thumb inward to the advancing but (up to that time) blocked nail This is accomplished by the incision exactly to the advancing nail edge The second is to provide an arched form or mould similar in shape and size to the advancing nail. This is accomplished by the insertion of an artificial nail through the arched tunnel and its fixation to the upper surface of the growing one Thus the advancing edge can follow a smooth splinted form superficially while adhering deeply to a clean granulating base during its advancement The pedicled flap over the artificial nail helps splint the latter and obliterates dead space, thus helping to provide a clean field during healing

The application of the technic employed in this patient's case to the problem of split nail seems quite obvious

THE EYELID AND SOCKET SURGERY

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Restoration of the eyelids is usually accomplished by full thickness grafts or partial thickness skin grafts. A full thickness skin graft is generally used for the lower eyelid and a partial thickness for the upper eyelid. It has been my practice to use the same for both upper and lower eyelids, namely $\frac{18}{1000}$ thickness of skin. Usually one eyelid only is reconstructed, but if all four lids require skin grafting, the upper lids are done at one operation, and the two lowers subsequently. The method suggested some years ago of attaching the lower eyelid to the upper by a small band of tissue has been unsatisfactory in my hands, as it affords too small a raw area for grafting, due to insufficient stretching of the lids.

The simple procedure advocated provides a greater raw surface to be covered by the skin graft, but does not permit repair of both eyelids at one operation. The method perhaps is old, and no claim for originality is made, although I have not been able to find it in the literature. A raw area is produced in the eyelid, larger than necessary, and the graft sewn in position. A shaped piece of lead plate of moderately light gauge, beneath which is a piece of lint, is laid above the graft, extending beyond it on all margins for 1.5 millimetres. The sutures are tied over the lead plate, which is larger than the graft, thereby exerting uniform pressure, and the lead bends to the contour of the eyelid. The lead plate is left in position for ten days to two weeks.

In reconstructing an enucleated socket, I am firmly of the opinion that the remaining mucous membrane should not be removed, but the socket should be extended in the upper and lower fornix and the inner and outer canthi. A skin graft $\frac{18}{1000}$ thickness is used to cover the raw surfaces produced by the extension. Any type of mould may be used but I prefer one of dental compound, frequently made in two pieces to afford greater depth, especially in the inner and outer canthi. Sufficient time must be allowed for softening and absorption of scar tissue within the entire socket. These artificially constructed sockets do not permit of much stretching, in contradistinction to the normal socket covered with mucous membrane. If at any time sufficient contraction has occurred to necessitate stretching, a further skin graft is indicated, before attempting to introduce a permanent artificial eye. It is useless to refer the case for an artificial eye until the surgeon is satisfied with the socket, although the patient may in the meantime wear a glass or plastic mould. I believe a good deal of trouble arises when the surgeon, dissatisfied with the socket, too early seeks the assistance of the artificial eye maker. Restoration of the enucleated socket is satisfactory, provided the surgeon is willing to give personal attention to the newly grafted socket for one month to six weeks before referring the case for a prosthesis. This delay is of great importance, allowing the graft to mature and permitting normal contraction to occur over the mould.

This brings us to the question of the prosthesis. Because of the shortage of glass at present, the plastic artificial eye is becoming more popular. I am of the opinion, however, that the plastic material as presently supplied is not hard enough, and that glass is still the material of preference for artificial eyes. Unfortunately, it is not obtainablo in sufficient quantity at this time.

The after-care of the reconstructed socket is the same as the caro of any part of the body. It should be cleansed with soap and water, dried thoroughly, and a thin film of ophthalmic ointment spread over the socket before introducing the artificial eye. Hairs, if present, should he removed.

The method of election for the correction of ptosis, in my opinion, is suspension of the upper eyelids to the occipito-frontalis muscle by narrow strips of fascia lata. I generally use two strips, introducing the fascia lata in the eyebrow area, passing it down near the inner canthus and above the tarsal cartilage to the centre of the eyelid, then upward to its original position in the eyebrow. This is repeated in the external part of the eyelid and eyebrow, and the ptosis overcorrected by making tension on the strips of fascia. I am aware that many other methods are advocated, but this has been moderately satisfactory in my hands.

SEVERE LID DEFORMITIES

Principles of Repair

ALSTON CALLAHAN, M.D., F.A.C.S.*

A free skin graft is usually indicated in a lid deformity caused by a loss of skin. When the deformity results from a disarrangement of tissues, pedicle flaps transposed from one area to another may aid greatly in its correction. A combination of these procedures performed in sequence may sometimes be employed to obtain a satisfactory result.

Detachment and displacement of the canthus, caused by severe trauma to and division of the palpebral ligament, is among the most deforming of lid injuries. Skin suturing alone will not correct it, and it is of the greatest importance to rejoin the severed palpebral ligament. If the division has occurred at the end of the tarsus, the tarsus should be rejoined to the ligament. If reunion of all lacerated eyelid structures is performed immediately, the incidence and degree of cicatricial deformities will be lessened considerably, but many cases are seen in which some of the structures have not been rejoined.

When extensive repair of a lid is required after the eyeball has been removed, the graft or flap is kept under more adequate tension if an acrylic conformer is kept constantly in the socket. Intermarginal lid adhesions are usually required to prevent contraction of eyelid grafts and flaps, and in such cases are constructed over the conformer. This ophthalmopedic also maintains ample space for an artificial eye when surgery is concluded.

The management of the following complicated case demonstrates the above mentioned principles of lid repair.

A man, aged 30, was injured in March, 1945 by an enemy mine explosion which resulted in a traumatic amputation of the right foot. He sustained penetrating wounds of the left eye, left orbit, left eyelid and forehead, and a penetrating vertical laceration of the right upper lid. Emergency surgery performed at the 96th Evacuation Hospital included evisceration of the left eye and debridement of the facial wounds.

Our first examination in June, 1945 disclosed the loss of the left eye, destruction of the lateral portion of the left upper lid, and severance of the lateral palpebral ligament (fig. 1). A stellate scar involved and distorted the external canthus. It extended temporally beyond the orbital rim (fig. 2). The distorted socket was not markedly contracted.

A long irregular scar of the glabella extended through the medial portion of the right upper lid, fixing it to the supraorbital rim. On downward rotation of the eye, the upper left lid remained elevated. The tarsus of the upper lid was severed from the medial palpebral ligament, and the lid margin was notched.

The cornea of the right eye showed a faint central nebula. The vitreous was

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FIG 1. LOSS OF THE LEFT EYE AND THE LATERAL PORTION OF THE LEFT UPPER LID FROM THE EXPLOSION OF A LAND MINE

The upper branch of the right medial canthal ligament has been severed, and the irregular penetrating scar of the right upper lid fixes the lid and holds it upward when the eye looks down

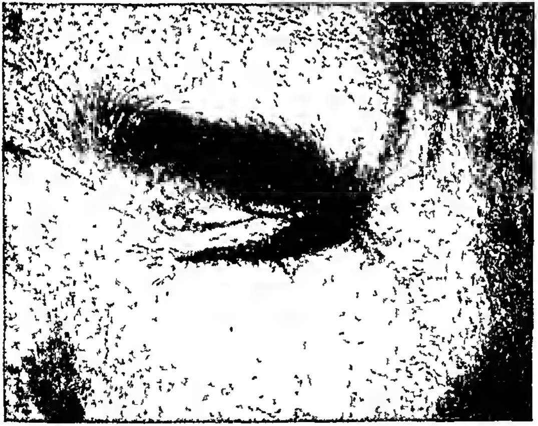


FIG 2 PREOPERATIVE APPEARANCE OF DEFORMED LEFT LID

The thick stellate scar has fixed the tissues of the lateral canthus to the deep temporal fascia over the supra orbital rim

hazy. A diffuse traumatic chorioretinitis in the healing stage was present in the superior nasal quadrant. A heavy migration of pigment had occurred. The central vision was reduced to 20/70. Radiograms showed no evidence of fracture of the right orbit.

In July, 1945 reparative surgery was initiated. Local anesthesia was secured by the injection of procaine hydrochloride (2%) with epinephrine hydrochloride (1:100,000), and was supplemented by the intravenous injection of morphine sulphate (gr. $\frac{1}{4}$). The large stellate scar extending from the skin to the deep temporal fascia overlying the periosteum was excised. The tissues were thus

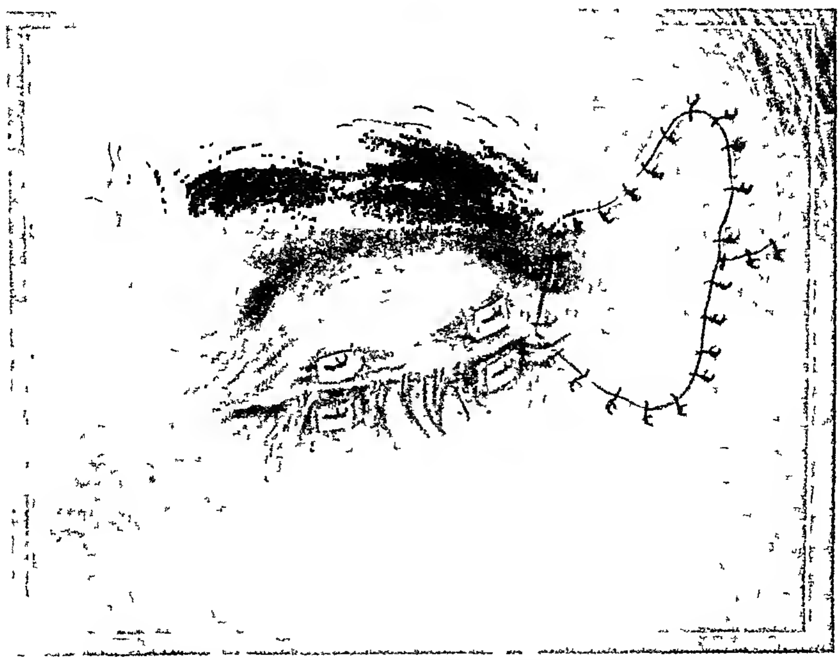


FIG. 3 THE STELLATE SCAR AND SUBCUTANEOUS CICATRICIAL TISSUES HAVE BEEN REMOVED AND ALL ABNORMAL TENSION RELEASED

An area of retroauricular skin is being grafted into the defect A subtotal intermarginal lid adhesion has been made to prevent contraction of the graft in the lid

relaxed from the tension of the incarcerating cicatrix. An acrylic conformer was fitted into the socket and a subtotal intermarginal lid adhesion was made to prevent contraction of the graft. Wheeler sutures on rubber pegs were used for coaptation.

In several of the extended points of the scar the tissues were directly reunited, and the oval defect which remained measured 4 cm. x 2 cm. A pattern of transparent celluloid was made of the defect, and traced with methylene blue on the left retroauricular area. This area of full-thickness skin was removed and fitted into the defect (fig. 3). The graft was sutured in place with interrupted sutures (braided silk 6-0), and a dry, firm pressure bandage was applied.

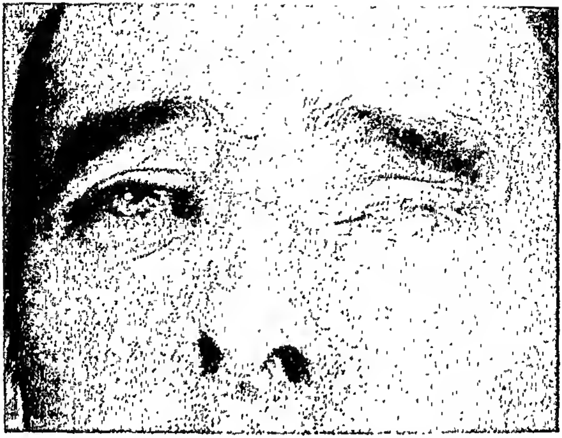


FIG. 4. APPEARANCE SIX WEEKS LATER

Deformities yet to be corrected are the displaced canthus and the oblique palpebral fissure.

FIG. 5 AN INCISION ANTERIOR TO THE LATERAL ORBITAL RIM IS CONTINUED TO OUTLINE A PEDICLE FLAP IN THE UPPER PORTION OF THE CHEEK

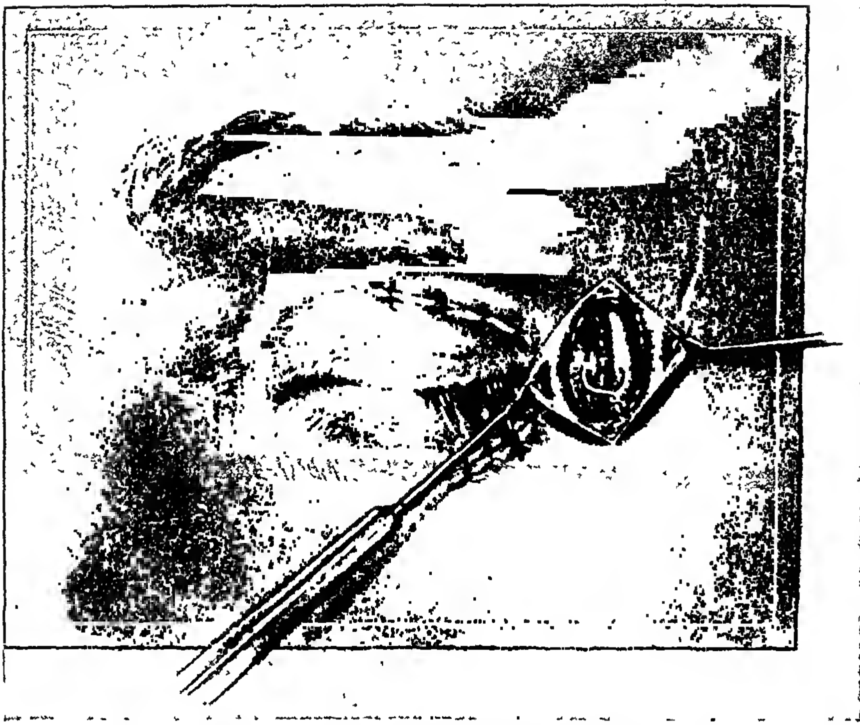


FIG. 6. THE PEDICLE FLAP HAS BEEN TRANSPOSED UPWARD

Proper positioning of the external canthus is attained by securing the remaining fragments of the lateral palpebral ligament with stainless steel wire to the orbital rim.

FIG. 7. SIX WEEKS POSTOPERATIVELY

Lateral canthus is now in correct position and palpebral fissure is horizontal.

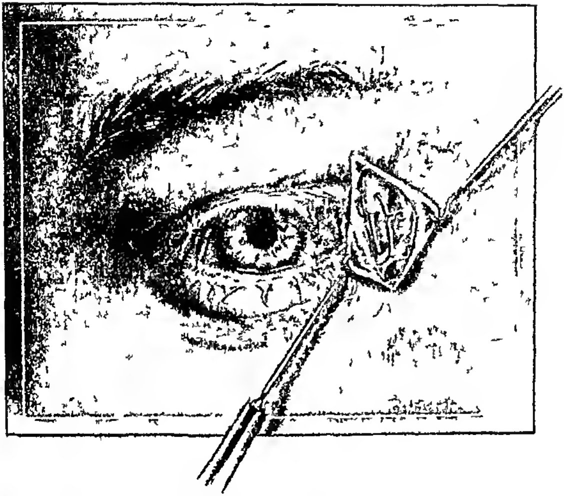


Fig 8 Repair of Right Upper Lid

Removal of the cicatrix exposes the detached tarsus Stainless steel wire joins the tarsus with the medial palpebral ligament Notching of the lid margin is corrected by the Wheeler halving procedure

Fig 9 The Subtotal Lid Adhesion Divided

A plastic eye has been inserted into the left socket The appearance of the right medial canth s is mpro ed

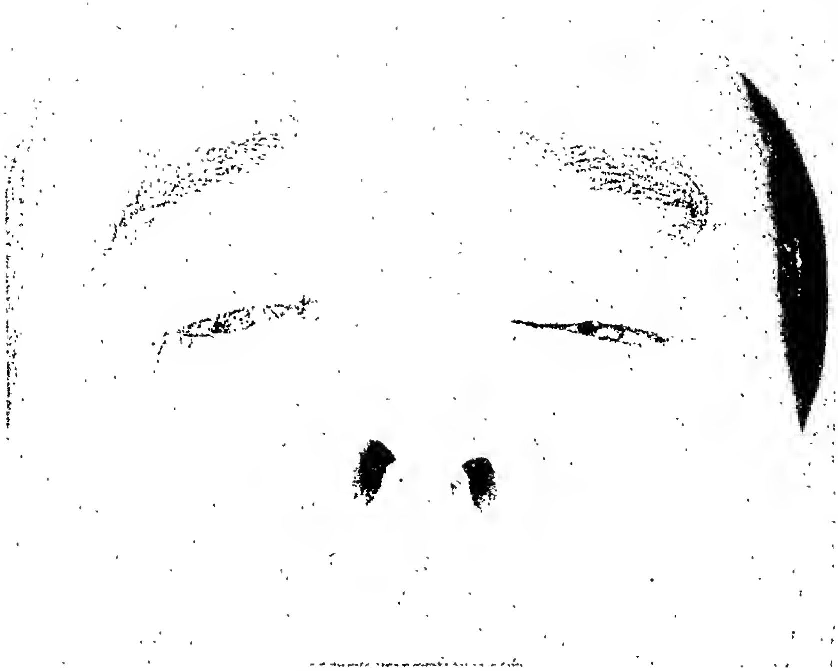


Fig. 10. On Downward Gaze, the Right Upper Lid is no Longer Fixed by the Cicatrix

Fig. 11. Postoperative Appearance
Showing free skin graft, pedicle flap and correctly positioned external canthus.

The graft grew well and observation six weeks later showed the beginning of improvement (fig 4) The second stage operation was then performed A transverse incision was made in the lateral portion of the left upper lid over the supra orbital rim, continued laterally along the orbital rim and extended to form a pedicle flap on the cheek (fig 5) The lateral orbital rim was exposed With a dental drill a small perforation was made through the margin of the rim about 1 cm inferior to the orbital tubercle Through this a strip of stainless steel wire (0 010) was inserted By means of a curved small cutting needle one end of this wire was brought through the small section of the lateral palpebral ligament which had remained attached to the lateral extremities of the upper and lower tarsi The ends of the wire were twisted together, thus pulling the lateral canthus down into its proper position (fig 6) After the last twist, the ends of the wire were directed posteriorly toward the orbit The skin and subcutaneous tissues were closed anterior to the wire, thus burying it It was allowed to remain permanently

The pedicle flap in the cheek was then transposed into position, forming the lateral portion of the upper lid The skin and subcutaneous tissues of the flap and the recipient area were joined with interrupted sutures (braided silk 4 0) The postoperative condition as seen a few months later was satisfactory (fig 7)

At the third surgical procedure, six weeks later, the right upper lid was repaired The extensive cicatrix resulting from the penetrating laceration of the medial portion of the right upper lid was removed This exposed the separation of the upper tarsus from the medial palpebral ligament They were reunited with stainless steel wire (fig 8) The skin and subcutaneous tissues were then joined with interrupted sutures (braided silk 4-0) Notching was prevented by approximating the tissues at the lid margin by the halving method of Wheeler Two months later the subtotal intermarginal adhesion of the left lid was divided, thus opening the left palpebral fissure

The patient was seen regularly at intervals, the last time being March 1948, three years after the injury The appearance was satisfactory (fig 9) When the eye was lowered the right upper lid no longer remained fixed to the supraorbital rim (fig 10) A detailed study of the left lids shows proper reconstruction (fig 11)

SUMMARY

A case is presented which demonstrates the management of multiple lid deformities with a free skin graft, a pedicle flap, intermarginal lid adhesions and wiring of the canthi

ANKYLOSIS OF THE TEMPORO-MANDIBULAR JOINT

CLAIRE L. STRAITH, M.D.* AND JOHN R. LEWIS, JR., M.D.

INTRODUCTION

No patient presenting himself to the maxillo-facial surgeon is more genuinely in need of aid or more appreciative after surgical interference than is the patient with ankylosis of the jaw. Esmarche, as early as 1851, recognized the need for surgical treatment and suggested what is essentially the modern concept of treatment. Many others through the years have added their contributions, but to Murphy and Blair is due the credit for popularizing the surgical treatment and for a more refined operative technique.

It is the purpose of this paper to present a resume of the clinical picture and surgical care of this disabling condition, and to stress the importance of secondary cosmetic procedures.

ETIOLOGY

In our experience the most common causes are trauma to the chin transmitted to the temporo-mandibular joints and infection in and around the joints (see Table 1). Some or all of our "Congential" cases may well have received trauma during delivery which resulted in subsequent jaw ankylosis. Blair, Risdon, and Padgett state that it is nearly always caused by a pyogenic infection in the vicinity of the joint. However, Thoma, Orlow, and Shands list the most frequent cause as the late result of a local traumatic lesion.

Among the causes may be mentioned the following: (1) abnormal intra-uterine development; (2) birth injury (by forceps in particular); (3) Trauma to the chin forcing the condyle against the glenoid fossa; (4) Malunion of condylar fractures; (5) injuries associated with fractures of the malar-zygomatic compound; (6) loss of tissue with scarring (war injuries in particular); (7) congenital lues; (8) primary inflammation of the joint (rheumatoid arthritis, septic arthritis, Marie-Strumpell's disease); (9) inflammation of the joint secondary to a local inflammatory process (otitis media, mastoiditis, osteomyelitis of the temporal bone or of the condyle of the mandible); (10) inflammation of the joint secondary to a blood stream infection (Septicemia, scarlet fever, tertiary lues); (11) metastatic malignancies, and (12) inflammation secondary to radiation therapy.

It occurs about equally in the two sexes, being slightly more common in males. However, in our cases the females predominate (62%). According to Orlow, 80% occur between 1 and 10 years of age, 15% between 11 and 20 years, and 5% between 20 and 30 years. In our series the onset occurred in all cases before the age of nine and the average age of onset was 2 years and 8 months.

* From the Straith Clinic for Oral and Plastic Surgery, David Whitney Bldg., Detroit 26, Mich.

TABLE 1

Summary of data of sixteen cases treated at the Straith Clinic

CASE	SEX	ETIOLOGY	AGE OF ONSET	DURATION OF ANKYLOSIS	SIDE INVOLVED	DEGREE OF ANKYLOSIS	TYPE OF OPERATION	ANESTHETIC	CHIN BUILD-UP
				yrs					
1 M O	F	Congenital	Birth	16	Right	Partial	Osteotomy of neck	Intratracheal ether	Solid preserved cartilage
2 M S	F	Trauma	6 yrs	20	Bilateral	Complete	Osteotomy of neck and coronoid process (bil 2 stages)	Intratracheal ether	Diced preserved cartilage
3 O G	F	Scarlet fever, Otitis media	5 yrs	4	Bilateral	Complete	Osteotomy of neck (bil 2 stages)	N_2O ether by tube	Solid preserved cartilage
4 C N	F	Scarlet fever, Otitis media	4 yrs	12	Left	Complete	Osteotomy of ramus	N_2O ether by tube	Solid antegeneus rib cartilage
5 B B	F	Mastoiditis	1 yr	14	Left	Partial	Osteotomy of ramus	Intratracheal ether	Solid preserved cartilage
6 C M	F	Congenital	Birth	9	Left	Complete	Osteotomy of neck	Intratracheal ether	Bone graft
7 L E	F	Congenital	Birth	4	Right	Partial	Osteotomy of neck	Intratracheal ether	None
8 R W	M	Trauma	1 yr	4	Bilateral	Complete	Osteotomy of ramus (1st stage)	Ether by tube	None
9 E M	F	Trauma	6 yrs	9	Left	Complete	Osteotomy of neck	Intratracheal ether	None
10 M P	F	Trauma	Birth	22	Right	Complete	Osteotomy of ramus	Intratracheal ether	None
11 G W	M	Peritonsillar abscess	1½ yrs	13	Left	Complete	Osteotomy of ramus	Local (1% novocain)	None
12 W C	M	Scarlet fever, Otitis media	3 yrs	2	Right	Complete	Osteotomy of neck	Ether by tube	None
13 V H	M	Scarlet fever, Mastoiditis	6 yrs	7	Left	Complete	Osteotomy of ramus	N_2O ether by tube	None
14 W R	M	Congenital	Birth	5	Bilateral	Complete	Osteotomy of neck (bil 2 stages)	Intratracheal ether	None
15 T H	F	Otitis media	9 mos	4	Bilateral	Partial	Osteotomy of neck on right, osteotomy of ramus on left	Intratracheal ether	Solid preserved cartilage
16 R P	M	Trauma	9 yrs	13	Bilateral	Complete	Osteotomy of neck and coronoid process (1 stage)	Intratracheal ether	None

PATHOLOGY

The pathological picture varies with the etiology, but may be grossly classified as to (1) the intra-articular type, (2) the extra-articular type, and (3) the combined extra-and intra-articular.

A

B

FIG. 1A. PREOPERATIVE APPEARANCE OF CASE 1

Though there has been partial unilateral ankylosis since birth, the mandible is not markedly asymmetrical. Note the marked underdevelopment of the jaw with a receding chin, however.

FIG. 1B. POST-OPERATIVE

The small pre-auricular scar is hidden by the hair. The chin has been corrected by a solid cartilage implant. The mouth opens freely.

In the intra-articular type there is progressive joint destruction with destruction of the meniscus, flattening of the mandibular fossa, thickening of the condyle, fibrous tissue fixation, shrinkage of the joint capsule with partial or complete obliteration of the joint, and possibly calcification and ossification of the scar tissue, making the mandible continuous with the temporal bone.

In the extra articular type the joint becomes splinted by a cicatricial or bony mass, which may progress to involve the joint structures as described above. In

cases of extensive fibrosis due to massive tissue injury or massive infection there is involvement of the coronoid process. In osteomyelitis of the temporal bone, for instance, the sigmoid notch may be obliterated and the condyloid and coronoid processes be fused together and to the base of the skull as one bony mass.

A

B

FIG. 2A. PREOPERATIVE APPEARANCE OF CASE 2

Bilateral bony ankylosis fixes mouth shut. Upper teeth and lower incisors have been extracted to facilitate eating and upper denture is in place.

FIG. 2B. POST-OPERATIVE

[illegible] Upper and lower dentures are in place [illegible] the scar beneath the side of the chin [illegible]

At operation this picture was found in Case 2 who had a fall on her chin as a child (Table 1 and figs. 2 and 3). It is interesting that the uninvolved joint remains essentially normal and the muscle function on the involved as well as the normal side may remain good or returned promptly even after ankylosis for many years.

SYMPTOMS

The symptoms depend on the duration of the condition, the degree of involvement and whether it is unilateral or bilateral. The typical case has inability

to open the mouth, difficulty in eating, and difficulty in talking. The limitation of motion is in direct proportion to the degree of involvement, the duration of

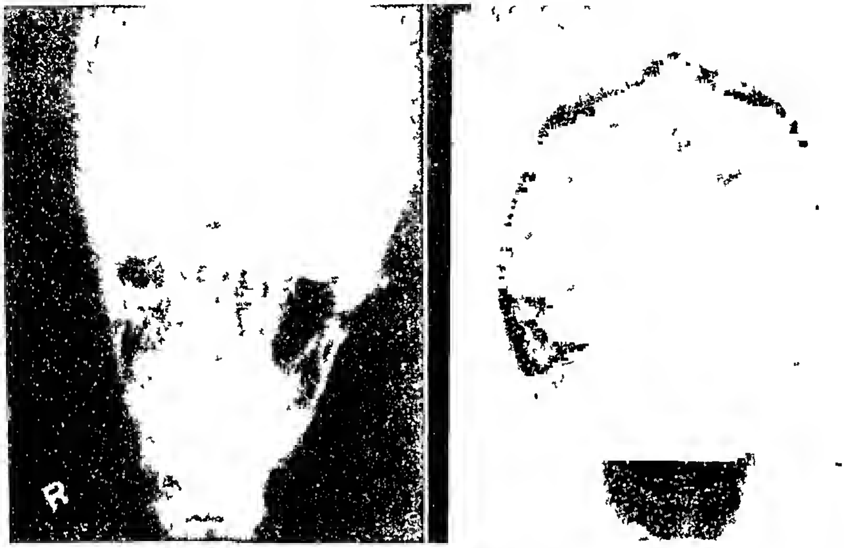


FIG. 3. INTERVAL X-RAYS OF CASE 2

They reveal the thickened ramus and obliteration of the joint on the right side and the osteotomy defect on the left side.

FIG. 4. PREOPERATIVE AND POST-OPERATIVE APPEARANCE OF THE YOUNGEST PATIENT OF OUR SERIES (CASE 7)

Note the slight asymmetry of the chin. This asymmetry will be minimized by early surgery. The jaw deviates slightly to the operated side upon opening.

the condition, and is more marked in bilateral cases. In fibrous ankylosis there is usually a small degree of motion in the affected joint, allowing about one half

to two cm. of opening (figs. 1 and 4). In bony ankylosis there may be as much as one-half cm. motion allowed by the elasticity of the bone and by motion in the cranial sutures (figs 2, 5, 7, 9)

Kazanjian called attention to a valuable differential sign Upon attempting to thrust the chin forward there is no motion in intra-articular ankylosis while

A

B

FIG 5A PREOPERATIVE APPEARANCE OF CASE 4
Complete left ankylosis of twelve years duration. Note the asymmetry of the chin
FIG 5B POST OPERATIVE
The asymmetry has been well compensated by a solid cartilage implant to the chin.

motion is present when the involvement is extra-articular. Thus in bilateral intra-articular ankylosis there is no forward thrust possible and no motion on either side.

There is deformity of the mandible in direct proportion to the youth at which it began. If ankylosis is present for any length of time before fifteen years, deformity can be expected.

In the case of unilateral ankylosis developed at an early age there is rounding of the cheek and a backward and lateral displacement of the chin on the affected

side (figs. 5, 6, 7). On attempted opening of the mouth the chin deviates to the ankylosed side and motion can be seen and felt in the unaffected joint.

In the case of bilateral ankylosis before bony development is complete, there is underdevelopment of the lower one-third of the face with a receding chin and micrognathia. Atrophy of the muscles of mastication and the unopposed action of the depressors of the jaw cause lengthening of the angle of the jaw and convexity of the bone downward. There is abnormal protrusion of the upper front

A

B

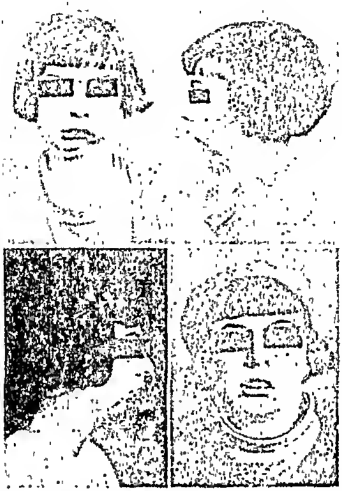
FIG 6A PREOPERATIVE APPEARANCE OF CASE 5
The chin is underdeveloped and asymmetrical
FIG 6B POST-OPERATIVE
A solid cartilage implant to the chin effects a more symmetrical chin and a nicer profile. Note the submental incision not yet healed A rhinoplasty would seem to be in order now.

teeth because of the pressure of the tongue in the small crowded mouth, contributing further to the bird face appearance. The teeth are crooked and carious because of poor occlusion and poor oral hygiene. (figs. 2 and 8)

The patients are usually underweight and underdeveloped, and this is assumed to be on a nutritional basis because of the difficulty of eating solid foods. Weight gain usually begins shortly after surgery.

DIAGNOSIS

Diagnosis is aided by the history of trauma or infection followed by progressive inability to open the mouth. The onset usually antedates the professional



A

B

FIG. 7A. PREOPERATIVE APPEARANCE OF CASE 6
Such marked underdevelopment and asymmetry of the mandible is unusual.

FIG. 7B. POST-OPERATIVE

... the chin. The full face
... The face would nat now
...k over from here.

FIG. 8. POST-OPERATIVE APPEARANCE OF CASE 3
Before and after the implantation of cartilage to the chin. Nate tha tight pinched appearanca of the chin before the cartilage addition.

consultation by several years. Patients try to care for their teeth even to the point of having them extracted before presenting themselves for correction of the primary trouble.

The symptoms are as described, difficulty in eating, talking (in complete ankylosis), and cleansing the teeth. Examination reveals the limitation of motion, the deformity of the lower jaw and protruding upper front teeth (when the onset was in childhood).

X-rays are very valuable in determining the presence and degree of bony deformity (fig. 3). It is especially important to know if the coronoid process is involved. Posterior and anterior stereoscopic x-rays should be taken. They give a good idea of the enlargement of the condyle and of the amount of hyperosotosis and exostosis present. Lateral views in the closed and forced open position are valuable. In some cases it may also be necessary to get stereoscopic semi-lateral views for good visualation of the joints.

Differential diagnosis includes hysteria, acute infections such as tetanus, reflex spasm from diseases of the mouth, acute parotitis, acute inflammation of the joint, meniscitis, and locking of the coronoid process by a depressed fracture of the zygoma.

TREATMENT

Unfortunately there is usually a long interval between the onset of the condition and the visit to the surgeon. In our series this interval averaged seven years and one month (Table). This interval allows in the young the development of the facial deformities so frequently seen.

Conservative treatment has no place in the treatment of ankylosis of the jaw whether unilateral or bilateral, fibrous or bony. Its use only prolongs the period of disability and allows an increase in the growth deformity. In several of our cases, forced dilation of the jaws had previously been tried one or more times with prompt recurrence of the symptoms. For the sake of completeness we might add at this point that in Case 3, who was treated surgically there was recurrence of the ankylosis on one side after $2\frac{1}{2}$ years and a second operation was necessary on that side. Also Case 14 had a partial re-ankylosis, but refused further surgery. The results are considered good otherwise.

The surgical treatment was first used by Esmarche who in 1851 suggested taking a wedge of bone out of the condyle. Humphrey, in 1856, removed the whole condyle. Verneuil in 1860 performed the first arthroplasty in treating a case of temporo-mandibular ankylosis. Rizzoli suggested simply cutting the ramus. However, Blair and Murphy popularized the surgical treatment and perfected the operative technique.

The anesthetic may be either local or general. Intra-tracheal anesthesia, is often impractical because the mouth cannot be opened widely enough. However in many of our cases the anesthetist has been successful in inserting the intratracheal tube through the nose into the trachea. When this can be done, it is very satisfactory.

Other types of general anesthesia are safe if there is room enough between the teeth to aspirate the throat. Local anesthesia may be used in the adult, and either direct infiltration or block of the Gasserian ganglion proves satisfactory.

The operative procedures may be classified as follows: (1) Arthrolysis, which

is difficult and unsatisfactory, (2) Arthroplasty, which is usually followed by a recurrence of the ankylosis, (3) Osteoarthrotomy, which is generally very satisfactory, and (4) Osteotomy, which has proved satisfactory also. Osteotomy may be performed at a high level, or at a lower level according to Risdon's technique.

The operative technique is fairly well standardized, in its essential parts, but there are many minor variations, a few of which will be mentioned. The chief precautions to be observed are to avoid the temporal artery and the upper branches of the facial nerve while exposing the joint and to avoid the mandibular nerve and the internal maxillary artery while performing the osteotomy.

Numerous skin incisions have been suggested and Brown suggests an intra oral approach. However, we prefer the external approach and make a "hockey stick" incision in front of the ear from a point immediately in front of the inferior attachment of the lobe to a point immediately in front of the tragus and overlying the zygoma. Then the incision curves forward slightly upward for about one inch. The resulting skin flap is dissected downward and anteriorly taking with it only the superficial fascia. Then the deeper layer of fascia is incised in line with the incision down to the temporal artery. Each area may be pinched with a hemostat before incising to rule out the presence of branches of the nerve. The posterior part of the attachment of the masseter muscle is then freed from the zygoma and pulled downward and forward to expose the joint and the condyle. Then one-half to three fourths of an inch width of bone is resected. The superior separation of the bone is made close to the joint and the inferior one one half inch or more below. The bony continuity may be interrupted by a chisel, Gigli saw, burr, or upcutting Kerrison punch forceps. However, the bony edges should be smoothed with Rongeurs if rough or uneven.

The condyle may be removed in some cases by inserting a chisel into the remnant *of the joint space and levering it out, at the same time cutting any strong* fibrous bands. However, in complete bony ankylosis there is no true joint space remaining.

Should the coronoid process be involved it may be necessary to extend the incision to resect it—unless it is resected blindly. However, it may be resected at a later date through an intra oral approach.

Due to the fact that the operator is working in a wound one and one half inches deep where normal anatomy has been distorted by scarring and by new bone formation, the anesthetist should insert dilators between the teeth and attempt to move the jaws while the operator keeps a finger in the wound to feel the motion. In this way any remaining bone block or dense adhesions can be palpated and interrupted. If adequate tissue has been removed there is usually no need for forced dilation of the jaws, and, if the jaws do not open, an overlooked ankylosis of the other jaw should be suspected. A certain amount of rigidity should be expected however in long standing cases because of shortening of the masseter and temporal muscles.

There is a space left at the point of resection of the bone (Figure 3) and there has been quite a bit of discussion as to the need for interposing tissue or foreign

materials between the bone ends to prevent their reuniting and to insure the formation of a false joint. Blair recommended sewing a flap of superficial fascia deep into the wound and others have recommended using temporal fascia or masseter muscle. Some of the foreign materials which have been used for the purpose are gutta, percha, wax, and celluloid. Kazanjian reported the use of fascia lata, and Figi inserted a cartilage block with good results. We use preserved fascia lata and are satisfied with our results. However, it may be argued that the ultimate result of foreign materials is to yield fibrous tissue and that we might as well let the space fill with a blood clot with the same results.

The substance which may prove to be best of all for the purpose is hemostatic oxidized cellulose ("oxycel") for it may be packed into the wound to accomplish hemostasis with the assurance that it will be absorbed. At the same time the acidity of oxycel is considered to cause a delay in callous formation in experimental fractures and bone defects, which should make it an ideal agent. Though we have closed the wound around a soft rubber drain, oxycel should make a drain unnecessary.

It might be mentioned that the horizontal incision of Baer, the vertical incision of Kazanjian, Risdon, and Kleinberg, the T-shaped incision of Wakeley, and the question-mark incision of Blair, have their adherents. Also Risdon states he prefers a lower resection of the mandible because of the decreased danger and the simplicity of the procedure. He makes an incision low over the angle of the mandible, frees the posterior part of the inferior attachment of the masseter and retracts it forward and upward almost to the bony deformity, resects one-half inch of the ascending ramus under direct vision, and sews the internal pterygoid muscle through the opening to the masseter. We have used the method (Table 1; Cases 4, 5, 8, 10, 11, 13), but prefer the one described above chiefly because of a better cosmetic result, and because we believe that a higher resection (neck of the condyle) places the false joint in a more natural location.

Though we have operated on both sides at one sitting in bilateral cases, we believe that as a general rule it is best to do one side at a time because it is less shocking to the patient.

It is interesting to note that in war injuries resulting in ankylosis of the coronoid process, Brown advocates treatment which varies with the extent of the injury. Early treatment which is so infrequent in civilian cases, is the keynote. Active motion and exercise are used in early mild cases, forced dilation and blocking the mouth open in more advanced cases, section of fibrous tissue and blocking the mouth open in further advanced cases, and in the most advanced cases, resection of the jaw below the ankylosis or resection of only the coronoid process if it is involved alone. He advises the intraoral approach to avoid the facial nerve, parotid gland, and to avoid external scars.

AFTER CARE

The after care of the patient may be divided into (1) the care of the false joint, (2) the care of the teeth, and (3) correction of secondary facial deformities.

Following surgery on the second side in cases of bilateral ankylosis the jaw

may drop open and there may be an open bite malocclusion. However, this may be expected to correct itself gradually by the normal muscle pull.

For the first three or four days following surgery the soreness of the jaw prevents much motion. However, we encourage active jaw motion as soon as possible (fig. 9).

On the second or third post-operative day the liquid diet is discontinued, a full diet started, and chewing gum encouraged between meals. After about two weeks massage of the masseter muscle is started, and also massage to any areas of the face affected by a transient facial paralysis, which, when it occurs, lasts three or four weeks.

After a period of four to six weeks, the patient is referred for dental care. Unfortunately it is often too late to save the patient's teeth and partial or complete dentures are necessary.

FIG. 9. PREOPERATIVE, 3 DAYS POST-OPERATIVE, AND 3 MONTHS POST-OPERATIVE APPEARANCE OF CASE 9

Early motion is encouraged after surgery

A very important point has been overlooked in most if not all of the papers on this condition. The surgical treatment has too often been considered finished when an adequately functioning jaw is obtained. Kazanjian and others have stressed the need for elongating the short side of the mandible when occlusion is poor. However, what of those who have satisfactory, if not excellent, occlusion? Only one of our patients was advised to have a further procedure because of occlusive difficulty. However, seven were operated upon to improve the appearance, either to correct a receding chin or facial asymmetry (figs. 1, 2, 5, 6, 7, 8 -A, B, C).

After the dental work has been completed we reappraise the patient. Most cosmetic procedures are indicated because of underdevelopment of the chin. This is particularly true in cases of bilateral ankylosis with the onset at an early age. However, it is unwise to correct the receding chin before the teeth have been repaired and replaced, for the dentures should be in place during the operation so that the operator may judge the correct amount of build-up. By using a local anesthesia and a short incision beneath one side of the chin, cartilage, either in the form of flakes, or a solid implant, is inserted in front of the symphysis

of the mandible. It is unnecessary to fix the solid implant to the mandible if it is properly shaped and a pocket of the correct size is formed to receive it. If flaked or diced cartilage is used, we insert it into the prepared pocket by means of a DeKleine "Chondrojet". Equally satisfactory, but more difficult technically is the use of a bone graft from the ilium as in Case #6.

In symmetrical retrusion of the mandible a cartilage implant to the chin suffices. In asymmetry of the mandible the chin is built up more on the short side (figures 5, 6, 7). A combination of a solid implant over the chin prominence and diced cartilage on each side of it gives a more gentle curve to the chin.

In the very young patient the Orthodontist may improve the occlusion and the symmetry. In the adult, in cases of marked asymmetry with marked malocclusion, surgical elongation of the short side of the mandible may be necessary. However, following creation of the false mandibular joint there is some improvement in occlusion and symmetry because of the flexibility and adaptability allowed by the "joint" space. Furthermore, most adults (judging from our patients) need dentures anyway. Only one of our patients was advised to have further surgery other than the "grafting" of cartilage to the chin. As stated in our series, the chin was built up in seven cases and it was advised for two patients who refused it.

By building up the chin, the patient's appearance and psychological outlook are both improved. The psychological importance of this procedure cannot be over emphasized.

SUMMARY AND CONCLUSION

We have presented a resume of the etiology, pathology, symptoms, diagnosis, treatment and after-care of tempero-mandibular ankylosis along with a summary of sixteen cases treated at The Straith Clinic.

It is a surgical disease, and conservative treatment is useless in our opinion. In the young, early surgery minimizes developmental deformities of the jaw. In patients of any age early surgery prevents atrophy of the jaw muscles and allows proper oral hygiene. After correction of the ankylosis and after necessary dental care it is important to complete the patient's rehabilitation by correcting the deformity of the chin. This can be done simply and is a very important part of the psycho-surgical management of the condition.

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PHARYNGEAL BURSA ASSOCIATED WITH CLEFT PALATE: REPORT OF 2 CASES

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The pharyngeal bursa may be defined as a mid-line diverticulum from the posterior wall of the nasopharynx extending from the lower border of the pharyngeal tonsil to the periosteum of the occipital bone. It is not a true bursa, meaning a closed sac of mesodermal origin, but it is called a bursa only out of deference to usage.

It was first described by Mayer in 1840 (1). However, it was not until 1885 that Thornwaldt (1) established that infection of this structure produced a definite clinical syndrome.

Two cases of pharyngeal bursa occurring with cleft palate are reported. There is only one other similar case (2) in the literature.

The first patient, C. E. K., was a boy of 18 months of age on his second admission to Vanderbilt University Hospital on March 22, 1946. His first admission at the age of six weeks had been for repair of an incomplete harelip on the right. The Mirault-Blair technique was used. The second admission was for repair of a post-alveolar cleft which began at a point one inch behind the alveolar ridge and extended through the uvula. In this operation the Dieffenbach-Warren-Langenbeck technique was used. During the procedure there was noted a mid-line cone-shaped depression in the posterior nasopharyngeal wall. The depression was probed for a distance of about two centimeters. There was no special evidence of inflammation present. This was undoubtedly a pharyngeal bursa.

The second patient, W. S. H., was an adult, seen in consultation August 23, 1946. His chief complaint was that food entered his nose through a cleft palate and that his nose and throat were sore and dry much of the time. Examination revealed a cleft involving the soft palate and about the posterior one-fourth of the hard palate. He had a red granular-appearing nasopharynx surrounding a pharyngeal bursa about 2.5 centimeters deep. He was advised to have the cleft palate repaired.

Comment: Many bursae are asymptomatic and are thus never diagnosed. Hollender (3) reported that out of 140 consecutive autopsies, examination of the nasopharynx revealed 10 bursae, none of which had been diagnosed before death. Snook (4) reported the incidence of these bursae in 201 human embryos above 15 centimeters in length to be 40%.

There has been much discussion about the etiology of the pharyngeal bursa. Von Lushka (1) believed it to be the remnant of Rathke's oral-hypophyseal pouch. Yankauer (5) thought that the bursa was not a special structure but was merely a deep medial recess of the pharyngeal tonsil. The rôle of adenoidectomy has been debated (5, 6). According to most observers (1, 2, 4, 7) the bursa is an embryonic structure formed by endoderm remaining in close contact with the mass of notochordal tissue which later forms the basiocciput. The site of the bursa is posterior to Rathke's pouch.

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Dorrance (2) pointed out that the bursa always occurs above the level of the superior pharyngeal constrictor muscle.

Clinical symptoms of infection of the bursa composing Thornwaldt's syndrome include a characteristic mid-line occipital headache, post-nasal discharge which may be purulent or mucoid, and low grade fever. Halitosis and bad taste in the mouth may be present. Arthritic pains (8) may confuse the diagnosis. The

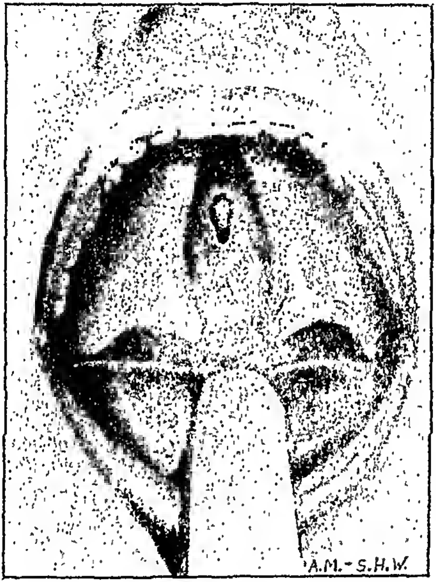

FIG. 1. PHARYNGEAL BURSA AND CLEFT PALATE

most characteristic symptom is periodic dropping down from the nose into the throat of hard cone-shaped crusts which are casts of the bursa.

The treatment at best is unsatisfactory. Cautery has been tried. Surgery in the form of heavy curettment with adenoid curettes is the most widely used form of therapy, but a scar is the only result.

CONCLUSION

Two cases of pharyngeal bursa occurring in patients with cleft palates have been presented. This finding tends to confirm the embryonic nature of the structure.

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EPIDERMOLYSIS BULLOSA HEREDITARIA

Report of a Case with Unusual Associated Deformities

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Epidermolysis bullosa hereditaria is a comparatively rare affection of the skin characterized by production of bullous lesions subsequent to slight trauma It is probably the least common of the congenital skin lesions Prior to World War II the number of cases reported in the literature were few in number Von Hebra is given credit for first describing the disease in 1870 (1) It was again described by Tillsbury Fox in 1879 and was finally termed "acantholysis bullosa" by Goldschneider in 1882 (2) Since the turn of the century numerous other cases have been reported This has been particularly true in the last few years With the advent of World War II and the subsequent massing of great numbers of people together many more cases have been recognized and reported in the literature In 2,281 skin lesions seen in his clinic, Greenburg reported five cases of epidermolysis bullosa or an incidence of 0 2% of all skin conditions seen (3)

The etiology of this condition is somewhat controversial It is generally agreed that basically the disease is hereditary in its origin This contention is supported by the numerous cases in which a familial history is present (3–10–12–13–4) Numerous hypotheses have been advanced as to the cause of the bulla formation There is an acantholysis at the junction of the epidermis and papillary dermis The theory was advanced in 1895 by Elliott that the bullae were formed by a sudden excessive exudation of serous fluid in an individual with an irritability of the cutaneous vascular system (4) In 1904 Wende came forth with the idea that there was an improper development of the rete cells as well as a lack of proper trophic innervation in the skin (5) It has also been suggested that the basic trouble is either endocrine in origin or possibly a disordered metabolism (6) The most likely etiology brought to light and the most widely accepted is that there is a defect in the upper derma, characterized by the absence of elastic fibres in the papillary and sub papillary regions of the derma (7) This was demonstrated by Kanoky and Sutton in both the traumatized and uninjured skin of hereditary cases (8) In recent years there has been some investigation of the porphyrins In some cases the excretion of urinary porphyrins has been found to be elevated (9)

The bullae arise any place on the skin subjected to undue pressure or friction There appears to be a definite predilection for the lesions about the fingers, toes, knuckles, ankles and elbows The lesions may be present at birth or may not appear for several days thereafter As a rule consitutional symptoms are not present, although LaSalle reports a case with digestive disturbances and gastric hemorrhage apparently referable to similar lesions of the gastro intestinal

tract (10). The formation of a bullous lesion is followed by healing, scarring and oftimes pigmentation. The latter may or may not be transitory. At times rather deep ulcers may develop; however, usually the bullae are superficial with surrounding evidence of atrophy and parchment-like wrinkling of the skin. The mucous membranes of the mouth and tongue are apt to show similar changes. On healing these give the appearance of leukoplakia. There may be pruritis. There may be a complete anonychia at birth or the nails may show dystrophic changes. The lesions are apt to improve in the winter and become more aggravated in the warmer months. Mikolsky's sign may or may not be positive (rubbing off of the skin by light rubbing). There may be all gradations of the disorder, giving rise to a differentiation into "simplex" and "dystrophic" types by some. There are occasionally associated congenital cutaneous defects.

The pathological picture as described by Ormsby and Montgomery is primarily attributed to an absence or defect in the elastic tissue of the skin. The bullae involve either the epidermis or the subepidermal layers. There is very little change in the epidermal cells. There is some associated mild inflammatory changes in the cutis. This is characterized by moderate infiltration by polymorphonuclear leucocytes, lymphocytes, eosinophils and plasma cells (9).

The diagnosis is usually easily made. Close observation will reveal the traumatic origin of the blisters. The congenital factor of the disease and the familial history substantiate the diagnosis. It is occasionally confused with the bullous type of pemphigus vulgarus. Rarely it may be confused with bullous impetigo contagiosa or with bullous erythema multiforme.

The treatment is mainly prophylactic. The patient should avoid any irritation of the skin (by pressure or friction) from clothes, daily activity, etc. It is important to treat the lesions in such a manner as to avoid secondary infections. Any acceptable therapy for a bullous lesion is indicated. Beinhauer treated a case in a female patient with anterior pituitary like hormone. He reported satisfactory results. The length of the follow up was not conclusive evidence of a cure (15). The congenital cutaneous lesions are treated as indicated.

The prognosis is not too good in regard to clearing up the tendency to bulla formation. Some cases have been reported to have cleared up with the advent of puberty. On occasion a very young infant may succumb, if the lesions become too extensive.

CASE HISTORY

This eleven year old white female was admitted to the hospital because of deformities of both hands.

This child, according to the mother's story, was well at birth. Shortly after birth she reports that some kind of medicine was put all over the baby's body. This was followed by the formation of blisters over the body and a contracture of the hands into the fist-like deformity noted on admission (Figs. 1, 2).

A personal communication with the physician who attended the mother at the time of delivery revealed that the hands of the infant were apparently in normal functional posi-

FIG 1. VOLAR APPEARANCE OF THE HANDS

The left hand appears to be less completely ensheathed This hand had been operated upon previously, but had quickly resumed its original position.

FIG. 2. VIEW OF DORSUM OF HANDS

Note the parchment-like character of the skin.

tion at birth. The baby, however, was born minus integument in probably six or eight places on her hands, arms, legs and feet In a few places there was a thin loose skin over the affected part. There was normal extension and flexion of the digits.

The frequent blistering has persisted, appearing with any moderate irritative trauma any place on the body. In 1942 an operation was performed on the left hand. This was not successful in correcting the deformity (Fig. 1).

The mother and father are alive and well. Two siblings, both alive and well. There is no family history of a similar condition, either on the maternal or paternal side. The period of gestation and delivery of the child was completely normal. The child had pneumonia at the age of two years with no resulting complications or sequelae. She has had chicken pox and whooping cough. Up to the present admission the child had been somewhat of a feeding problem, eating only what caught her fancy.

Fig. 3. View of the Lower Extremities

Note the bullous lesions on the left leg and the scarring about the knees. This was true of the skin elsewhere on the body, especially about the elbows.

Physical examination revealed a white female child of 11 years of age, giving the appearance of a slight child of about 6 years. She was moderately alert and cooperative. The skin over the entire body was of a thin, parchment-like character. It was of a consistent brownish color with here and there splotched areas of a lighter hue. There were numerous "sores" over the body, particularly the wrists and elbows, in various states of resolution from newly formed, oozing bullous lesions to hard, crusted areas. These measured from 1 cm. to 6 or 8 cm. in diameter. The tongue had a porcelain-like sheen as did the rest of the oral mucosa. The tonsils were enlarged to the midline, cryptic, but not injected. The mucosa over these organs was identical to the oral mucosa elsewhere. She had enlarged posterior and anterior superficial cervical lymph nodes. The heart and lungs were clear to percussion and auscultation. The limbs were spindly, with a paucity of subcutaneous and muscular tissue; although action and strength of the latter appeared normal.

There were numerous bullae and crusted lesions over the extremities (Fig 3) The fingers and toes bilaterally were ensheathed into a position of complete flexion by a thin, parch ment like layer of skin (Figs 1, 2) This was continuous with the skin of the proximal member as if held in a mitten of cellophane Upon asking the child to move the fingers, they could be seen to move slightly as if being seen through a window

FIG 4 X RAY OF BOTH HANDS SHOWING THE EFFECT OF THE ENSHEATHING EPITHELIUM UPON THE BONY STRUCTURE OF THE HANDS

FIG 5 X RAY OF BOTH FEET SHOWING DEFORMITY OF THE PEDAL PHALANGES
The flexion position of the toes being identical to those of the fingers

Examination of the blood revealed a hemoglobin of 10 5 gm and a white cell count of 10,550 The urine was negative The total serum protein was 8 16 gm The chloride level was 92 9 mg/L, while the non protein nitrogen was 25 mgm % The blood Wasserman was negative A test for urine porphorins was also negative

X ray examination (Figs 4, 5) of the hands and feet revealed no intrinsic bony ab normalities There was a fixed flexion deformity of the fingers and toes by reason of their soft tissue epidermal ensheathment

Pathological examination of a segment of skin from the hand revealed an absence of the

FIG. 6. PHOTOMICROGRAPH OF SECTION OF SKIN REMOVED FROM THE PALM OF THE LEFT HAND AT TIME OF OPERATION

The entire epidermis is lacking in this specimen. The corium can be seen to be thickened. There is a dilatation of the suderiferous glands.

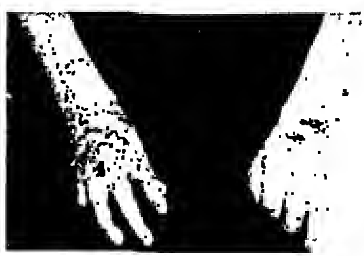

FIG. 7 FIG. 8

F G. 7. VOLAR SURFACE OF HANDS FOLLOWING OPERATION

and was repaired several months prior to repair of the left. Note the flexion of the fingers, especially the thumbs and little fingers. These will require repair.

FIG. 8. VIEW OF DORSUM OF HANDS

ote the bullae on the left hand. These were the result of the usual minor trauma sub- nt to complete post-operative healing. The complete anychia of both hands can be

epidermis in its entirety. The corium was found to be thickened and contained dilated blood vessels. This was compatible with a diagnosis of epidermolysis bullosa (Fig. 6).

The first operation performed was the elevation of a double pedicled flap from the left

lower thorax and upper abdomen This was sutured back into its bed in anticipation of using it later as a covering for the hand, when the next operation was performed When the hand was unfolded later it was found that the flap was not needed The right hand was corrected first The parchment like covering was peeled off the hand This denuded only a small area on the dorsum of the hand The fingers were opened out with a minimum of trauma some denuding being produced on the flexor surface of the fifth and the webbed area of the first The skin of the hand thus revealed appeared normal There was a complete anychia (Fig 2) Healing was very prompt with some contracture deformity of the fifth digit as well as narrowing of the first webbed space The child was admitted to the hospital three months after the first procedure At that time a similar operation was performed on the left hand This was somewhat more difficult as that hand had previous operative attention There were more denuded areas about the dorsum of the hand in the webbed space of the thumb, on the finger tips and about the flexor surfaces of the fingers Healing was again very prompt There were subsequently moderate contracture deformities of the fingers as with the other hand (Fig 7, 8)

Certain aspects of this case are worthy of consideration The pathological picture presented on microscopic, as well as gross examination, showed the typical deficiency of elements in the epidermis In classifying this case one would place it in the category of the more severe or dystrophic form of the disease, although it would appear that, regardless of the extent of the skin involvement, the simple or dystrophic form of the disease is merely a gradation of the identical process The diagnosis of epidermolysis bullosa hereditaria is a comparatively simple problem provided that one keeps in mind (1) The traumatic origin of the lesions and (2) the congenital source of the disease In this instance both were present in spite of a vague history In many cases there is a definite family history following Mendelian principles, however, this patient gave no such history In reviewing the literature we found instances of congenital cutaneous abnormalities such as alopecia or anychia We found no cases described in which the cutaneous deformities were similar to those of the accompanying case It was interesting to note that following surgical correction of the deformities of the hands, the uncovered skin and newly formed epithelium assumed a more normal appearance This, however, was not lasting, and after several weeks it began to take on the typical parchment-like character of the skin elsewhere on the patient's body This was also true of the double pedicled flap which had been raised on the lower thorax and abdomen

From the story presented by the attending physician it is logical to assume that the deformities of the hands and feet were not of congenital origin, but rather were due to the early bullous lesions of the hands There was apparently a lack of the superficial layers of the skin of the hands in the major flexion creases as well as in apposing surfaces (as between the fingers) Lack of active treatment and bandaging of the hands in a position of flexion of the fingers resulted in a gradual proliferation of epithelium over a given raw surface and bridging of such new tissue from digit to digit Over a prolonged period of time this process resulted in a smooth contiguity of the epithelium of the skin of the hand into a complete mitten like ensheathment

Further corrective plastic procedures will be instituted on the hands at a future date.

SUMMARY

1. The literature on the subject of epidermolysis bullosa hereditaria is reviewed and discussed.

2. This is a comparatively rare congenital abnormality of the skin, characterized by the appearance of bullous lesions of the skin upon but slight trauma. This is most likely due to a deficiency of the elastic elements of the skin.

3. A case is presented in which there are associated deformities of an unusual nature, characterized by a parchment-like ensheathment of the hands.

4. It is noted that skin under such a circumstance can be bridged by a comparatively remote, viable epithelial layer without any apparent effect on the former.

5. A short resumé of the treatment of these deformities is presented.

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REPAIR OF SURFACE DEFECT OF THE CHEST FOLLOWING GANGRENE

CHARLES F STEISS, M D [1]

San Francisco, California

A type of infection caused by the hemolytic streptococcus which primarily involves the subcutaneous tissues with resulting thrombosis and gangrene, has been described by Meleney (2) in 1924, who reported on twenty cases coming

FIG 1 GANGRENOUS INFECTION OF CHEST COMPLICATING CHICKEN POX CONDITION ON ENTRY

under his observation in China An external wound, however minor, apparently furnishes the source of entrance of the organisms A rapidly spreading infection develops, which burrows along the subcutaneous spaces, not involving the muscle layer Thrombosis and sloughing of the surface tissues follows, metastatic abscesses may also occur The mortality in Meleney's series in 1924 was 25% The use of chemotherapy and antibiotics has no doubt done much to reduce this figure However, the infection remains a very serious and toxic

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Fig. 2. Healthy Granulating Ulcer following Debridement and Local Therapy. Condition 3 Weeks after Entry

Fig. 3. Postoperative Condition Just Prior to Discharge. The Grafted Area Has been Excised and the Defect Closed by Direct Approximation of Wound Margins

one, which is always associated in its late stages, with a reparative problem The case reported below is the first of its type which has come under my observation I believe that this infectious process is rarely seen in the United States

Due possibly to the fact that the case was not seen by our service until its later stages, at which time secondary infection obscurred the bacteriological findings, culture showed predominantly staphylococcus aureus, and not hemolytic streptococcus However, the clinical picture so closely resembled the cases described by Meleney, that I believe this case may be placed in the same category

The defect which resulted from the gangrenous process involved a considerable area on the anterior chest at the base of the neck which at first seemed to require the transplantation of skin in its repair However the adaptability of the surrounding tissues made it possible to excise and close the entire defect measuring approximately 16" x 4½", after primary grafting had been accomplished

The patient was a 7 year old female, who was admitted to our service in July of 1945 She was in a serious condition with a large sloughing wound at the base of the neck and chest This infection was a complication of chicken pox, for which the child was being treated at home The patient responded well to supportive treatment including blood transfusions and penicillin, and on July 25th she was taken to surgery and a debridement performed Following this procedure the wound rapidly took on the characteristics of a health granulating ulcer On August 7th the entire area was grafted The dermatome was used in obtaining the grafts, of which there were two, each measuring the full dimensions of the drum These two grafts just covered the wound

Approximately 85% of the graft was a successful "take" The remainder of the wound was subsequently healed by application of additional razor grafts

The original plan of treatment anticipated eventual fractional excision of the grafted area However, scar contraction worked in our favor reducing the width of the defect, and it became apparent that we would be able to excise and close the entire area at one operation

This was done on November 6 1945 The surrounding tissue was widely undermined and advanced and closed by direct approximation of the wound edges without undue tension

Healing occurred without complication and shortly thereafter the patient was discharged

SUMMARY

A case of bacterial aerobic gangrene complicating chicken pox is reported, resulting in an extensive chest defect Repair by excision and closure is described

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"VACUTOME"—A NEW MACHINE FOR OBTAINING SPLIT THICKNESS SKIN GRAFTS*

DONALD E. BARKER, M.D.

Philadelphia, Pa.

Prior to 1939 the average surgeon had great difficulty in obtaining split thickness skin grafts of any size. In 1939 Padgett (1) introduced the dermatome which advanced the taking of skin grafts tremendously. It seemed at first that here was the final answer to the problem of taking skin grafts. However since that time a number of disadvantages of the method have become apparent. These are: 1. Failure of the skin cement to stick to the dermatome. 2. Failure of the cement to stick to the skin. 3. Time lost waiting for the skin cement to dry. 4. Difficulty in getting skin cement in war torn areas. 5. Cutting of the skin too deep beyond the drum area. A more ideal machine would be one that could be used without extensive preparation of the skin, no waiting, and would utilize materials such as vaseline and a suction machine which are common to every operating room.

In July 1947 a machine was introduced at the Graduate Hospital which utilized the principle of a suction cup with a knife attached. The knife could be set at variable distances. During the past nine months this machine has been used on numerous patients with excellent results. Early it became apparent that unless guides were added a graft of uniform width could not be obtained. Then too, one might cut too deep if the skin were taken from an area wider than the width of the vacuum cup. Fig. 1 shows a photograph of the vacutome from the front with its various parts. For cutting the graft a "6" Ferris Smith replaceable skin graft blade is used. This is relatively inexpensive and can be stropped on a razor strop after each case. It is recommended that it be used only a couple of times before resharpening.

TECHNIC

A blade is inserted into the blade holder "C" until it is in position. The set screws "A" are adjusted until the blade just comes in contact with the base of the suction box. Now the set screws are turned counter-clockwise until the desired setting is obtained. A small amount of vaseline is wiped over the blade to permit free cutting, and a thin layer of vaseline is spread over the skin. The suction tube is attached to the machine at "E". We are now ready to cut the graft. I usually inspect the area to make sure the 4 inch suction cup will have a wide enough area so there will be no chance of breaking the suction. A trial run over the area is a good idea, assuring one that the skin area is adequate. This is done by holding the blade away from the skin and pulling the machine slowly across the field. The assistant or nurse holds a tongue blade just in

* The Vacutome is manufactured by Johnson Mfg. Co., Chippewa Falls, Wis.

front of the area where the graft is to be cut and gently depresses the skin. This has two purposes: 1. To flatten out the skin nearest the blade, and 2. To give counter traction to the skin. The tongue blade is held in place and not moved during the cutting. When the graft is ready to be cut the machine is placed in position on the skin, and held in place until the suction machine gauge registers 15. Now the knife holder is rotated on its axis until the blade just touches the skin. This is usually about one inch away from the box. With a gentle sawing motion the skin is cut until the blade guide "F" touches the suction box. The box is now slowly pulled along while the skin is cut with the moving blade. Care must be taken to pull the box slowly, otherwise the knife will tend to rotate away from its cutting position near the suction box. One

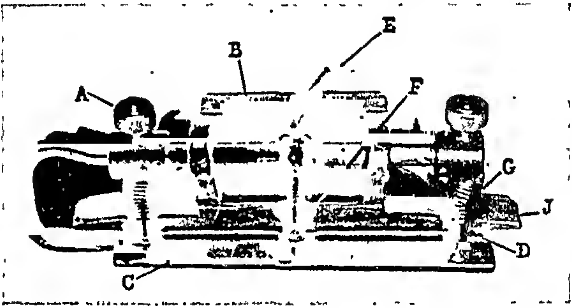

Fig. 1. Parts of Vacutome

A. Setting screw	E. Suction attachment
B. Suction box	F. Blade guide
C. Blade carrier	G. Tension spring
D. Knife blade	J. Skin guard

does not have to press hard against the skin to take a good graft. The machine is set on the skin and pulled along with very little pressure.

CLINICAL RESULTS

The first case operated on was J. J., a colored girl, age 6, who was transferred to the plastic section six weeks after a burn. She presented thick granulations on both thighs. We felt that the right thigh area would heal over, but that the left should be grafted. A graft .016 inch thick was taken from the ventral surface of the right thigh. Fig. 3 shows the blade as it touches the skin about one inch away from the box. It is at this point that the cutting is started. The suction box is not moved however until the blade guide touches the box. Fig. 4 shows the donor area. Usually the graft will roll up over the blade carrier as happened here, unless it is grasped with hemostats and pulled out.

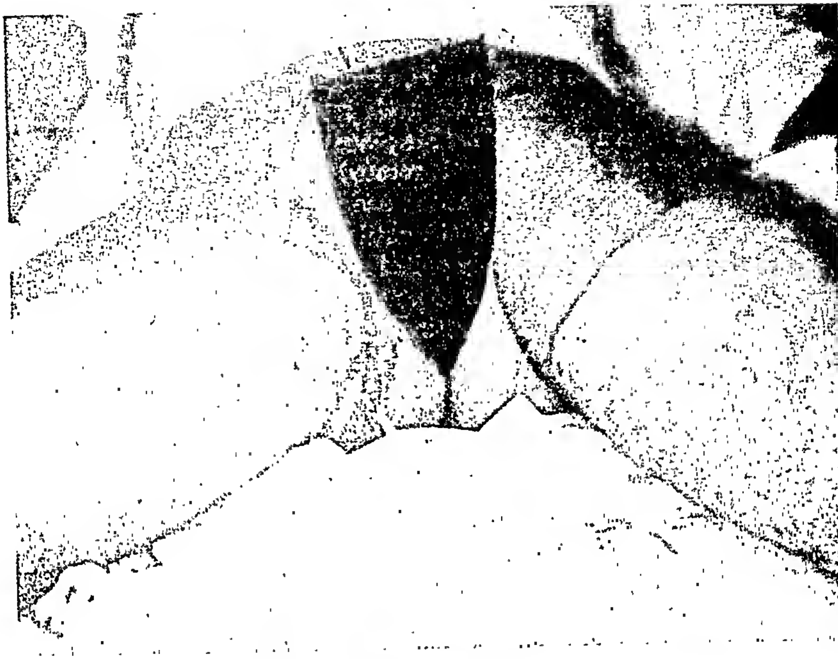

Fig. 2. Appearance of Wound

Fig. 3. Blade in Cutting Position

Fig 4 Donor Area with Graft Curled Over Knife Carrier

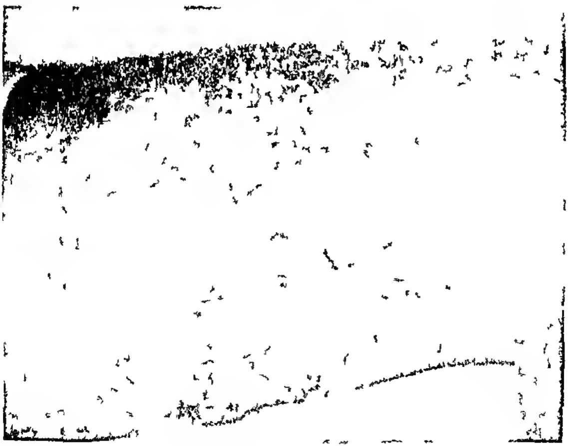

Fig 5 Graft at Eight Weeks

This does not bother the cutting in the least. Fig. 5 shows the grafted area two months after the operation. Donor area has healed readily, Fig. 6.

In another case, E. H., age 19, the immediate problem was to cover an area of granulation tissue and denuded bone in the left temple region. He was admitted to the hospital three weeks after an auto accident and presented a large area of denuded bone, Fig. 7. He was taken to the operating room and part of the outer table was chipped off. By the fourth day following the operation, Fig. 8, a fine layer of clean granulation tissue was present and the area was skin grafted. Fig. 9 shows the graft being cut from the thigh, the

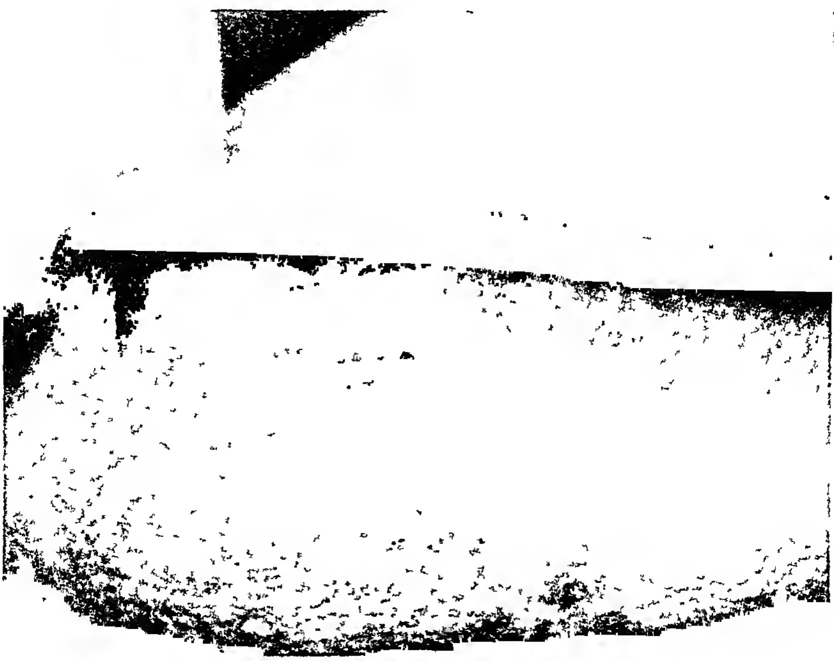

FIG. 6. DONOR AREA AT EIGHT WEEKS

skin having been pulled over the blade holder. A good uniform graft .020 inch in thickness was obtained, Fig. 10. Because of the potentially infected area the graft was dressed daily from the fourth day on with boric acid gauze. The graft was well healed by the seventh day, Fig. 11, and the patient was discharged three weeks after admission, with instruction to return later for reconstructive surgery.

Grafts have been taken from the following areas: inner, ventral, and lateral thigh; across the chest, Fig. 12; obliquely around the thigh; across the upper back; and up the lumbar area. Like all mechanical devices the vacutome requires a little practice before one becomes used to handling it. Fig. 12 shows Dr. Curtis using the machine for the first time and obtaining a graft 4x8 inches from the thigh area.

Fig. 7. Wound on Admission

Fig. 8. Appearance Four Days After Curetting

Fig. 9. Graft being Pulled Over Guard

Fig. 10. Completed Graft

FIG. 11. APPEARANCE OF GRAFT SEVEN DAYS AFTER OPERATION

FIG. 12. CUTTING GRAFT ACROSS CHEST

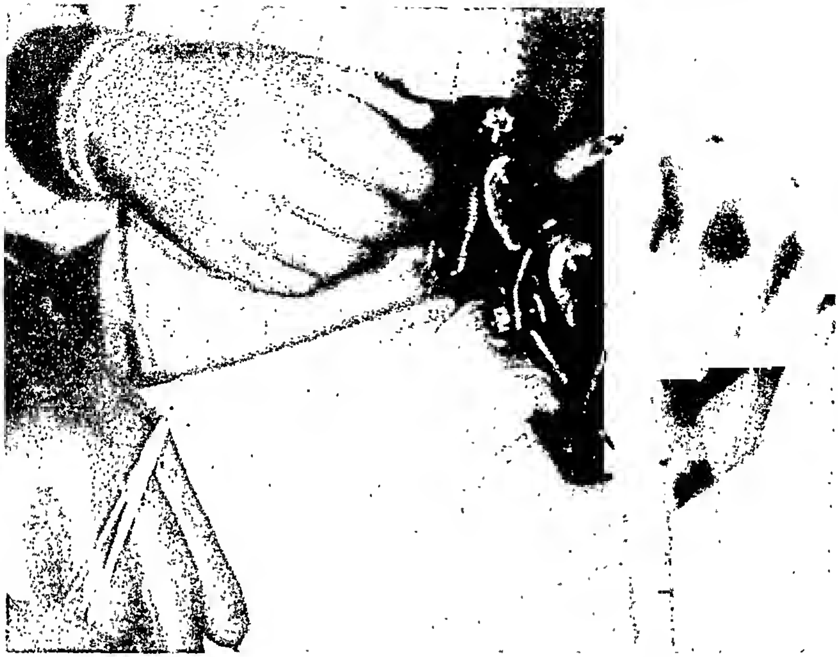

Fig. 13. Dr. Curtis Using Machine First Time

Like all grafts taken without the use of skin cement, the grafts appear thinner than those taken with the Padgett dermatome This is probably due to the fact that the glue tends to thicken the skin and give it a little more body A graft taken from the back 025 inch in thickness looks about the thickness of a dermatome graft 020 inch thick In measuring a series of grafts with the micrometer, I found that at times the grafts were 002 to 003 inch thinner than the original setting of the vacutome This however was not considered to be a disadvantage A microscopic section of a graft 020 inch thick shows the cleavage plane to be deep in the dermis, cutting through sebaceous glands and hair follicles, Fig 14

A setting of 015 inch is used only in grossly infected areas, or in taking grafts on children This gives a fairly thin graft For adults a setting of 020 to 025 inch is routinely used Care should be taken in operating on people beyond the age of 60, where there is a marked thinning of the skin, especially in the layers of the dermis Often in cutting a graft 020 inch thick from the inner thigh area fat tissue will be obtained Also due to the thin skin the suction pressure has to be regulated In the average adult a pressure reading of 15 to 30 is usual In people over 60 the suction should not be allowed to get above 20.

DISADVANTAGES

One cannot obtain a graft with the vacutome from a thin depressed abdomen. Likewise in a thin and wasted individual marked contour changes in the rib area would present a difficulty For this type of case it is suggested that saline be injected beneath the skin area in a method described elsewhere (2)

SUMMARY

A new machine is introduced for cutting split thickness skin grafts which utilizes the principle of suction Grafts of varying thickness can be taken from nearly all areas of the body Uniform grafts can be cut 4 inches up to 15 inches long, the length being determined by the skin area available. Skin guards prevent gouging of the skin beyond the desired area

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Hugh Auchincloss, M.D.

OBITUARY

Hugh Auchincloss, M.D.

News of the sudden death of Dr. Hugh Auchincloss on September 21, 1947, came as a sad shock. He was a pioneer in the field of hand surgery, and a Founder Member of this Society. All of us have been influenced by his skill as a surgeon, his inspiration as a teacher, and his important additions to knowledge of hand surgery. These contributions were based upon profound thoughtfulness, and painstaking research.

Dr. Auchincloss was born in New York City, December 28, 1878. He died suddenly of coronary thrombosis while on vacation in Northaven, Maine. He graduated from Groton in 1897, and Yale in 1901. His M.D. degree was obtained at Columbia University, College of Physicians and Surgeons in 1905. He served his interneship at Roosevelt Hospital under Doctors Blake and Brewer, and often expressed admiration for their surgical prowess, and knowledge of gross pathology. Dr. Auchincloss recognized the importance of accurate pathological diagnosis, and in 1908, working with Dr. William C. Clarke, the laboratory of Surgical Pathology was started at Presbyterian Hospital. In 1912, he assisted at the re-organization of the Vanderbilt Clinic, the Out-patient Department of Presbyterian Hospital. In the same year he entered into private practice. When the surgical service of Presbyterian Hospital was re-organized in 1921, under the Directorship of Dr. Allen O. Whipple, he became Chief of the Second Division, and Associate Professor of Surgery. He later became Professor of Clinical Surgery until his retirement in 1946, when he became Professor Emeritus, Consulting Surgeon, and Honorary Member of the Medical Board, of which he had been a member for many years. He was a member of the Board of Trustees of Groton, and President of the Grenfell Association of America.

His chief hobby was his work, and he was always busy planning new procedures, or devising ingenious appliances. He was exceptionally competent in working with glass, metal, rubber, or plastic material, and he derived the utmost satisfaction from the production of just the right apparatus to meet the need of the moment, and it did not matter how late was that moment, nor how tired he felt. Every member of a large and faithful personnel has more than once had the experience of following the smell of burning rubber suspecting that a sterilizer was dry, only to find the trail leading to the offices and shop of the Chief, where he painstakingly cooked a special curve into some rubber tube.

Dr. Auchincloss's secondary hobby was the collection of letters, pictures, and other memorabilia concerning Florence Nightingale. He had the most extensive collection in existence, and had given them to the School of Nursing at Presbyterian Hospital.

Dr. Auchincloss always carried a heavy teaching schedule. He particularly enjoyed individual teaching in the operating room, or group discussions such as those on surgical staff rounds, starting at 8:00 A.M., and attended by a large group of house staff, nurses, social workers, students, and visiting doctors. He always maintained great interest, and managed to emphasize important points by provoking an argument. Sometimes the discussions were quite heated, but he could always change the subject by moving to the next patient. The true value of these ward discussions was sometimes missed, especially by those who were short on humor, or who were new to the technique. He compelled everyone to participate, and to express an opinion about a diagnosis, or a plan of treatment. Everyone was forced to take a stand, and be prepared to defend it. There was no chance to take a neutral position. In doubtful cases he carefully recorded opinions on the chart so that all might learn when the true situation became known. He spoke clearly, and loud enough for all to hear, often turning to face the group, or showing some unusual physical sign to each person individually. These were no ordinary rounds where the house officer whispered some report to the chief, and received a mumbled reply; where those on the periphery of the crowd are so much shifting dullness. The ability to force participation on one and all was an outstanding quality, but he also possessed great personal understanding, especially for the young doctor with a problem. He was always generous and helpful. He was an example of faithfulness to his patients. A house officer was sometimes shamed for a haphazard history by finding it supplemented by several closely written pages, and a few excellent drawings by the Chief himself. It was almost a nightly occurrence for the resident on late rounds to cross the path of the Chief in a darkened corridor. He had just been around making sure everyone was safe and comfortable for the night, or he was worried about the condition of some particular patient. At these times he often carried out an indicated treatment that could have been passed to a nurse or an orderly. He was pleased to teach the nurses at every opportunity, and could rub a back, make a bed or give an enema as well as the best.

Dr. Auchincloss gave many papers and demonstrations. One of the best was his annual breast symposium which was attended by throngs of people from all corners. His patients were most appreciative, and loyal, and his follow-up most efficient so that there were always large numbers of old and extraordinary cases. His most important papers were his classical monographs on the breast, and on the hand in Nelson's System June 1930, Vols. 3 and 4.

Dr. Auchincloss greatly enjoyed his participation in the organization of the American Society for Surgery of the Hand, and had great hopes that it would help in the dissemination of knowledge in this field. His passing leaves a great void in our group, as well as in his hospital and medical school, and for that matter in surgery as a whole.

THOMAS W. STEVENSON, M.D.

ANNOUNCEMENTS

AMERICAN SOCIETY OF PLASTIC AND RECONSTRUCTIVE SURGERY

A meeting of the Endowment Committee was held at the New York Athletic Club on Friday evening, April 9, 1948 at which Doctors Jacques W. Maliniac, Clarence R. Straatsma, Edward A. Kitlowski and Lyndon A. Peer were present. At this meeting all aspects of the organization of a nonprofit charitable, scientific and educational foundation were discussed in detail and legal counsel was instructed to prepare the necessary papers for the incorporation of such a foundation under the name of the Foundation of the American Society of Plastic and Reconstructive Surgery, Ltd., pursuant to the Membership Corporations Law of the State of New York, and to draft by-laws covering election to membership and other matters.

A draft of the certificate of incorporation and by-laws has been prepared and will be presented to a meeting of the Executive Committee of the Society and to the voting members of the Society.

The proposed certificate of incorporation definitely restricts the Foundation's activities to those of a charitable, scientific and educational nature so that the Foundation may qualify not only as tax exempt with respect to its own income, but as being the type of organization to which gifts may be made and deducted by the donor to the extent permitted by federal and state laws.

The purposes for which the Foundation is to be formed are to carry on experiments, studies and research in the field of plastic and reconstructive surgery; to promote high standards of training, practice and study in such field; to grant or confer prizes or other recognition for outstanding achievement or accomplishment in the field and to disseminate medical and health information to the profession and to the public respecting plastic and reconstructive surgery.

The members and directors of the Foundation are to be identical and are to be divided into five (5) classes one fifth (1/5) of which ultimately will be elected for each year and will serve for five (5) years. The by-laws provide that no member shall be eligible for election unless nominated by the Society thereto and that at all times a majority of the members and directors must be members in good standing of this Society.

The Endowment Committee feels that the Foundation which they have proposed will provide a vehicle through which the members of this Society and all others interested in the field of plastic and reconstructive surgery may make donations which will aid in research and practice of the specialty and result in substantial benefit to the public generally.

LYNDON A. PEER, M.D.
Secretary of the American Society
of Plastic and Reconstructive Surgery

BRITISH JOURNAL OF PLASTIC SURGERY

We have recently received the first issue of the British Journal of Plastic Surgery, April, 1948, which is to be published quarterly by Messrs. E. and S.

Livingstone, Ltd., of Edinburgh. The Editor is A. B. Wallace, F.R.C.S.Ed. and on the Editorial Committee are such eminent surgeons as Sir H. D. Gillies J. N. Barron, Sir A. H. McIndoe, M. C. Oldfield, T. P. Kilner, W. Hynes, R Mowlem and R. P. Osborne. Following introductory forewords by Sir Alfred Webb-Johnson, President of the Royal College of Surgeons of England and J. M Graham, lately President of the Royal College of Surgeons of Edinburgh, several excellent articles on diversified problems of interest to the plastic surgeon occupy some seventy pages. Thus, this new venture has been launched under most auspicious circumstances and we voice the sentiments of everyone practising the specialty of plastic surgery in the United States in wishing those responsible every success. We are sure that a large subscription list will be enrolled from this country.

R. H. I.

July 1948

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

GRAFTS

Barker, D E Pigment Changes in Experimental Whole Thickness Skin Grafts *Arch Path 44* 163, Aug 1947

Barker is concerned with the problem of the invasion of pigment from a skin graft into the surrounding skin and, *vice versa*, from the surrounding skin into a white graft Circles of whole thickness skin, 17 mm in diameter, were cut in each of two areas, one white and one black, respectively, and were sutured into the opposite area in each of 50 guinea pigs Eleven of the white and 11 of the black grafts were complete takes The following changes were noted In 4 weeks the circular graft shrank to about two thirds or one half of the original size Following this shrinkage the black graft pigment gradually surrounded the white area for a period as long as 93 days In direct contrast, the white graft was gradually invaded by the surrounding black pigment until the graft was no longer visible In 9 of the 11 guinea pigs, this invasion of the white graft was completed in 60 to 80 days two of them taking 103 and 120 days, respectively

Hair growth The growth of hair was sparse, but grew out of the grafts in the original direction of growth Of particular interest is the fact that, in the case of the white grafts white hair continued to emerge in the grafted area for as long as 5 months, even though the white graft had long since become pigmented

The work presented here shows that when a large unpigmented skin graft is transplanted to a colored skin area, the surrounding pigment gradually invades the graft

This result is in complete agreement with the earlier work of Loeb and others, who used smaller grafts, and is opposed to that of Seevers and Spencer. As Trotter and Dawson have previously stated, the direction of the hair growth apparently remains constant, being unaffected by the movements and pressure of the surrounding hair growth.

Wolfe, J. J.: Symposium on Plastic and Reconstructive Surgery. I. Methods of Tissue Transfer. *Kentucky M. J. 45:* 421, Nov. 1947.

In this brief discussion on methods of tissue transfer, Wolfe has managed to cover the fundamental conditions governing the procedures of plastic surgery.

He considers each of the various types of tissue commonly used in plastic surgery, giving the special characteristics of each, the indications for the use of each, the methods of handling, and the difficulties encountered in obtaining a successful end-result.

The types of tissue considered are: (1) Epidermal graft or Ollier-Thiersch graft, (2) split graft of Blair, (3) full-thickness or Wolfe graft, (4) cartilage grafts, (5) bone graft, and (6) pedicle or flap graft.

Cannon, Bradford: Some Recent Developments in Plastic Surgery. *Surg. Clin. North America*, Oct. 1947, p. 1106.

Several methods in plastic surgery which have been developed or perfected during World War II are presented by Cannon. These methods include the extensive use of direct flaps on the extremities, full-thickness grafts from the base of the neck for face repairs, composite grafts from the ear in nasal reconstruction, and repair of losses of the ear with local tissue and preserved cartilage.

CLEFT PALATE AND HARELIP

Beatty, H. G.: Cleft Palate and Lip. *Ann. Otol. Rhin. & Larying. 55:* 572, Sept. 1946.

Beatty emphasizes the need for complete work-up to avoid unnecessary risk, and outlines preoperative and postoperative orders and technic for dealing with clefts of the soft and hard palate in babies and children. One hour before operation, the patient is given an hypnotic, usually nembutal (no atropine or narcotic). Except in the case of adolescents or large children, the preferred anesthesia is ether-oxygen. He prefers the Brophy mouth gag with ether tube attached (made of black nickel plate on the outside and bright nickel inside for reflection within the mouth).

A No. 1 plain catgut is placed through the tip of the tongue for retraction. An incision by means of a MacKenty half-circle knife is made along the extent of the cleft border where the oral and nasal mucous membranes join. Elevation of the soft tissues and periosteum of the hard palate from the horizontal plates of the superior maxillary bone and palatine bone is begun and continued with Brophy elevators. This should be done carefully as tearing or mutilation of the apex of this crevice produces subsequent fibrosis in the newly formed palate. No attempt is made to fracture and include the horizontal bony plate in the palatal flaps. Detachment of the flap extends toward the alveolar processes as far as necessary in each individual instance to secure good approximation. Incisions along the lateral borders of the palate are made only when required to secure adequate approximation of the medial borders of the cleft.

The next step is careful detachment of the hard and soft palate from the horizontal plates of the palate bones. Commencing with the mesial line, one can dissect out the attachment of the five muscles, which are duplicated on each side, and each of which has such relations to a mesial line that in case of cleft or split, it serves more or less to draw the parts posterolaterally. The entire border of each cleft is pared sufficiently to secure good approximation without tension and an adequate surface for good blood supply.

Two pilot sutures of No. 1 moistened plain catgut are then introduced through each body of the soft palate in order to draw No. 20 gauze silver wire through each body of the cleft muscular soft palate. Cleft borders are then approximated with horsehair or steel on tantalum wire, usually both. The nasopharyngeal mucosa is closed with horsehair up to the attachment to the

aponeurosis. When the entire palate cleft has been closed, the silver stay wires are united over the lead plates as stay sutures to overcome the contraction of muscles which would tear out the suture line. No tension is put on these sutures to draw the cleft borders together, as this would result in necrosis.

This procedure gives good speech and a nearly normal-looking palate. The functional success of cleft palate technic should be evaluated only when the patient has attained full growth.

Peer, Lyndon A.: Management of Cleft Palate Deformities. *J. New Jersey State Dental Soc.* *19:* 21, Nov. 1947.

Cleft palate deformities in conjunction with harelip as congenital deformities of unknown origin are described by Peer. He states that in his series of 3000 cases only 50 per cent gave an hereditary history. He stresses the fact that individuals who have a positive history should understand that if they marry some of their children will probably be affected.

He advises early closure (6 weeks) of harelip (if concomitant with a palate deformity) and the optimum age of 15 to 20 months for palate closure. Section of the vomer is to be avoided; the prominent middle segment of the lip is forced back into approximate position by steady manual pressure. *He states that the maxillae are* underdeveloped and that the apparent protrusion of the premaxillae is normal. The problem of obtaining anatomical relationship is for the orthodontist after the lip and palate correction. He advocates that Federal or State government subsidy of orthodontists to attend each clinic and work in close cooperation with the plastic surgeons would accomplish a workable solution of these problems. He does not state whether or not the plastic surgeon should or should not be subsidized, but that the orthodontist is the absent member of the harelip and cleft palate team.

Stressing the importance of avoiding the formation of a tight flat lip which is too long, he closes the bilateral lip by suturing the two maxillary segments to the middle segment to form the complete central portion, and uses all excess vermillion (after providing a nasal floor) to reinforce the deficient red border of the middle segment.

If there is a palate defect only, Peer advocates closure just at the time when the child begins to talk—at 18 to 20 months, for the following reasons: (a) There is a higher mortality rate in earlier operations. (b) There is no material gain in feeding or general development if the operation is done early. (c) Palate tissues are utilized in word formation at the proper time. (d) Delay beyond the 2-year period causes the development of faulty speech habits. Extensive palate closures are generally quite successful whether done by the Von Langenbeck method of sliding flaps, or by fracture through the two bony shelves and uniting them together in the median line (Warren Davis method). He uses the Dorrance push-back operation for lengthening a short palate.

The author claims that in his experience intelligent patients with cleft palate associated with double harelip develop good speech after repair without formal speech training in contrast with those affected with a wide single harelip and extensive palate cleft.

Protheses for the hard palate with closure of the soft palate are recommended only in those cases where the cleft in the hard palate is too wide for satisfactory repair. Evaluation of late results is summarized.

Oldfield, Michael C.: Cleft Palate and the Mechanism of Speech. *Brit. J. Surg.* *35:* 173, Oct. 1947.

Oldfield stresses the obligations of the surgeon in supervising after-care of cleft-palate patients in the attempt to gain normal speech. Briefly, he discusses the localization of the speech center in the cerebral cortex and the coordinate function of the association centers. The speech center, as presented by Marie in 1917, includes the whole of the temporosphenoidal lobe, and much of the parietal and lower frontal convolutions. This is usually found on the left side in right-handed individuals, and *vice versa.*

The mechanism of the production of speech sounds involves three components: (1) expiration of air—action of the respiratory muscles, (2) phonation, or vibration

of air—action of the vocal cords, and (3) resonance and articulation—pharyngeal, buccal and nasal action. The most rapid and intricate muscular movements occur in the mouth and pharynx, but the ventricular bands or false vocal cords also assist in the production of speech.

There are four kinds of speech sounds. There are vowels, diphthongs, consonants, and affricatives. In the production of vowel sounds there is no obstruction to the escape of air. These are produced by the voice. Consonants require some obstruction to the escape of air. The character of the sound depends on (a) the site of obstruction, (b) the degree of obstruction, (c) the position of the velum, and (d) the presence or absence of the voice.

In teaching the cleft palate patient to produce consonants, it is important to show him exactly where to place his lips and tongue. By means of radiography, the exact positions have been studied by Barclay, Nelson, and Jones. A coat of bismuth meal was placed on the lips, tongue, and palate, and lipiodol was injected along the floor of the nose on the upper and lower surfaces of the palate. Roentgenograms taken during speech then revealed the exact position of these structures in the formation of consonants.

After repair of the nasopharyneal sphincter and the palate, other factors may persist. These are (1) psychological causes, (2) irregularity of the upper incisor teeth, (3) deafness, owing to the frequency of otitis media in cleft palate cases, and (4) stiffness of the upper lip. These must be corrected as well as the anatomical defect, whenever possible.

Speech lessons are best given in three classes: (1) children under 3 years, (2) children of 3 to 12 years, and (3) adolescents and young adults. Classes should be pleasant, without boredom, and include such as blowing games, visual practice, consonant practice (with a mirror), the formation of sentences, songs, and reading aloud.

FINGERS

Graham, W. C., and Riordan, D., Capt.: Sublimis Transplant to Restore Abduction of Index Finger. *Plast. & Reconstruct. Surg. 2:* 459, Sept. 1947.

Motor paralysis of the ulnar nerve or trauma to the first dorsal interosseous muscle causes inability to abduct the index finger and prevents grasping between the thumb and index finger.

Graham and Riordan have used various tendon transplants to restore the lost motion of the index finger. The most satisfactory method has been transplantation of the sublimis tendon from the ring finger. The sublimis is cut proximal to the interphalangeal joint through a short lateral incision leaving a short stump to reattach to the proximal phalanx. Its two slips are split proximally to withdraw it from around the profundus tendon. The sublimis tendon is withdrawn through a transverse incision at the wrist, and the volar fascia of the forearm is opened proximally to allow the tendon to be brought around the radial side of the forearm without acute angulation. A subcutaneous path is made behind the thumb over the anatomical snuff-box and first dorsal interosseous space to the radial side of the proximal phalanx of the index finger. A short incision is made on the radial side of the base of the finger, and the sublimis tendon is sutured into the proximal phalanx. Either the insertion of the sublimis may be in bone or it can be sutured to the intrinsic sleeve and the first dorsal interosseous tendon. The finger is immobilized in abduction and extension, with the wrist slightly flexed, for 3 weeks.

Poyver, Herbert: Immediate Repair of Severed Tendons with End Results in 140 Cases. *Texas J. M. 42:* 534, Jan. 1947.

One hundred and forty cases involving several tendons of only one finger are reviewed by Poyver. In 29 cases flexor tendons were divided, and in these, 14 patients (48.2 per cent) showed some residual disability. All 111 patients with injuries to the extensor tendon 23 (20.7 per cent) had a residual disability. In all cases, operation was done within 4 hours of the injury since most of them were industrial injuries.

Poyver does not recommend primary repair later than 6 hours after injury because of the danger of infection. He cleanses the fingers with benzene to do away with greasy dirt and then scrubs the hand with soap and

a brush under running water for 10 minutes Nerve block at the elbow or general anes thesia is employed, and a blood pressure cuff is used to check bleeding Careful débride ment and complete hemostasis are essential Additional incisions made to locate severed tendon ends should be parallel to flexion creases and located on anterolateral or dorso-lateral aspects of the fingers The author repairs both tendons at the same time if both flexor tendons (sublimis and profundus) have been severed In such a case, exposed suture material is placed on the palmar aspect of the sublimis tendon and on the dorsal aspect of the profundus tendon Active exercise is started the day following operation

INJURIES

Johnson, R. T., Lt -Col. R A M C , and Dutt, P , Capt. I A M C : *Brit J Surg* War Surgery Supplement No 1 Wounds of the Head

Dural lacerations over paranasal sinuses, in the opinion of Johnson and Dutt, constitute a danger of meningitis, aerocele, or abscess formation, which in the absence of operative interference persists for years after the injury, if not indefinitely Chemo therapy has considerably reduced the risk of early meningitis, but late meningitis, arising at a time when the effects of an old head injury have long been forgotten, may be well established before adequate treatment can be given

During the Burma campaign the need for accurate diagnosis of all sinus brain wounds was intensified by the increasing incidence of a virulent type of meningeal and brain infection due to a variant of *E coli* which was resistant to penicillin

Varieties of Fracture These fractures fall into four groups according to the way in which the dural laceration is produced

(1) Sinus-dural communication as a result of direct injury by missile or displaced bone

(2) Sinus dural communication due to dural splitting associated with a fissured fracture

(3) Discrete sinus-dural communication at points along a fissure fracture

(4) Discrete sinus-dural communication with isolated ethmoidal fracture

Radiographic Diagnosis Frontal wounds with missile tracks across the sinuses, injuries with gross distortion of the floor of the anterior fossa, or marked depression of the posterior wall of the frontal sinus leave no doubt as to the necessity for opera tion But accurate knowledge of the ex tent of the damage will prove of the greatest value in making a decision as to when exploration should be carried out and in planning the minimum operation on an ill patient It is the isolated lesions in the ethmoid and sphenoid region which cause most difficulty A very high standard of radiography is necessary in projecting these cells This is due to the multiplicity of small cells that are superimposed upon each other, the inability to project these cells in silhouette without the superimposition of numerous other structures such as the nasal conchae, and the difficulty in evaluating the findings obtained The routine coronal mental view may show no change, or increased trans lucency due to loss of bone or the presence of air, or, more frequently, opacity due to blood in the brain or the sinuses

Stereoscopic posteroanterior views with varying degrees of tilt are useful In the oblique position, as for the optic foramen view and tilting the tube 15° or 20° toward the feet, it was found that a good definition of the posterior and middle ethmoids could be obtained, especially where the orbital roof extension of the frontal sinus was small

Many beautiful diagrams are given to illustrate the different views

Treatment Access to the dural sinus de fects anterior to the groove for the anterior ethmoidal vessels and nerve is easy by the extradural route Fractures of the dural sinus defects posterior to this groove require a high standard of radiography They are more difficult to assess, and the intradural route is the method of choice

Indications for early treatment are (1) Small penetrating wounds limited to the frontal sinus in which roentgenograms show no fractures farther back (2) Small missile wounds through or near any paranasal sinus with suspicion of intracerebral clot or abscess These are explored through a frontal flap

Indications for delay are (1) Where there is considerable difficulty in diagnosis, he

cause of uncertainty as to whether the missile has passed through the ethmoids or sphenoids on its way to the brain. (2) Where the foreign body is seen to be in the vicinity of a vital brain center. (3) Where the defect is believed to be the result of fissuring and not of direct injury. (4) Where the radiography shows a posterior ethmoidal or sphenoidal defect; a very extensive operation with wide exposure being required. (5) Where meningitis is present.

Results: There were 28 deaths in 88 missile wounds and 10 blunt head injuries in 98 cases. Of these fatalities 7 involved no operation. There were 10 deaths in 42 cases in which treatment was carried out in the acute stage. Eight of these 10 deaths were considered to be due to fatal brain damage.

In a second group of 18 patients, 8 already had had a preliminary operation carried out forward; one of these died. This group of 18 patients resulting in one death had definitive treatment of the dural-sinus communication with graft during convalescence.

In the third group of 21 patients, a preliminary operation only was done; 10 died.

Editorial Comment: These three articles are chiefly concerned with the neurological aspects of a group of complex injuries which also concern the plastic surgeon. Particularly full and well illustrated accounts of the neurosurgeons' management of these cases in the early stages are given, as well as well classified pathological and radiological anatomy of the injuries. They indicate the plastic contribution to the wound closure by appropriately planned and cut scalp flaps. The problems of time and methods of reduction and fixation of associated fractures of the facial skeleton are not discussed. Nor are the early problems of maintaining the airway and those concerned with the choice of anesthesia described.

Otto, Thomas O.: Wound Closure Without the Use of Grafts. *Ann. Surg. 125:* 778, June, 1947.

The purpose of this article by Otto is to deplore the current indiscriminate use of split thickness skin grafts and to set forth the possibilities of wound closure anatomically and physiologically by two ancient surgical methods, namely, the radical undermining of sound margins and interpolation (surgical transplantation of tissue).

The author states that in dealing with 11,000 battle-wounded men all wounds were closed by excision of wounds, undermining of the margins and the use of marginal flaps when necessary. The greatest problems encountered, according to Otto, were in treating the thousands of men who were received with wounds that had been previously covered by split thickness grafts.

A detailed description of the blood supply of the skin is included along with specific information regarding the technic of radical undermining of skin and elevation of marginal flaps.

REPAIR OF DEFECTS

Elkins, C. W., and Cameron, J. E.: Cranioplasty with Acrylic Plate. *J. Neurosurg. 3:* 199, May, 1946.

Acrylic acid plates have been used by Elkins and Cameron for skull defects in a series of 70 cases between June, 1943 and January, 1945. The technic of the procedure is accurately and minutely described. They have perfected this technic so that it may be carried out in one procedure and with local anesthesia, where formerly two procedures and a general anesthesia were necessary.

In their series of 70 cases they have had seven infections as complications, two of which necessitated removal of the plates. One plate had been in position for 10 months and was essentially unchanged in appearance.

The authors contend that the material is satisfactory for the repair of skull defects because it is readily accessible, and the plate can be made by any competent dental technician. The completed plate is a result of a direct impression of the defect and conforms to the defect. They further claim that there is a minimum of operative trauma. They state, however, that this procedure would be disadvantageous in traumatic cases in which the wound is potentially infected.

Carmody, John T. B., Comdr. (MC) USNR: The Repair of Cranial Defects with Special Reference to the Use of Can-

cellous Bone. *New England J Med* *234* 393, Feb 21, 1946

The arguments for and against the use of tantalum are discussed by Carmody at great length He claims that tantalum has been and continues to be the most satisfactory metal used in cranioplastics It is light, non magnetic, and chemically inert, is easily modeled and does not require pre liminary casting He states, however, that tantalum is not suitable in all cases Heavily scarred areas have broken down, and the body has extruded this metal like any other foreign body Also the possibility of cortical fixation has not been dis proved Another factor to be considered is that the opacity of tantalum prevents the possibility of future roentgenographic studies

The author then gives two illustrated case histories in which the tantalum plate had to be removed because of infection Cancellous bone chips from the ilium (auto genous) were then placed in the defect, resulting in complete recovery

Carmody states that the purpose of the article is not to condemn or undermine the use of tantalum in cranioplasty but rather to advance the use of cancellous bone graft ing in selected cases He believes that cancellous bone may be the material of choice in selected cases and that its use should not be relegated to the past

Albritten, Frank F., Jr.. Simultaneous Repair of Peripheral Nerve and Soft Tissue Defects in the Forearm *Am J Surg 125* 447, Apr 1947

In the repair of extensive injuries to the extremities, as pointed out by Albritten, it has become an accepted measure to fill the defect with a graft of normal fat and skin before the reconstruction of the underlying nerve, bone or muscle is undertaken This method has one notable disadvantage in that it requires a period of waiting during which the underlying elements may become scarred, adherent or atrophic

Albritten describes a plan whereby the soft tissue defect and the underlying nerve injury are repaired simultaneously The first stage consists of the following (1) The scar tissue is meticulously excised (2) The nerve is explored, mobilized, transplanted and sutured (3) A pattern flap is raised from the abdomen and sutured to the defect in the forearm, the exposed area in the donor site being covered by approximation of the adjacent tissue The second stage is undertaken 3 or 4 weeks later, when the flap is divided along its attachment to the abdomen

EPITHELIOMA

Pack, G. T., The Management of Pigmented Nevi and Malignant Melanomas. *South M J 40* 832, Oct 1947

As pointed out by Pack, malignant melanoma is the most malignant and dangerous of all accessible cancers The neval cell and its malignant derivative, the melanoma cell, have their origin in relationship to the complex tactile end-organ apparatus In this sense, these tumors are derivatives of the peripheral nervous system and are neuro-ectodermal in origin Occasionally the melanoma cells may be so actively reproductive that the formation of pigment does not occur, and the tumors may appear to be non pigmented

Pack further states that pigmented nevi and melanomas are not commonly found in the darker races, particularly in the Negroes and Mongols When found in the Negro it is most often in such locations as the sole of the foot, the nail bed, and the oral mucosa, regions which are not ordinarily deeply pigmented Malignant melanomas occur relatively more frequently in blond in dividuals, particularly those persons who have extremely pale skin

The regional distribution of pigmented nevi and melanomas in the skin are not exactly the same Both tumors occur with considerable frequency on the face and neck, and with equal frequency in the skin of the trunk Pigmented nevi are not commonly found on the feet or on the genitals This suggests that any nevus on the feet or geni tals would be more likely to undergo ma lignant degeneration, explainable on the basis of trauma by repeated irritation

The author suggests the term prepubertal melanoma to indicate a group of nevi which resemble melanoma histologically but do not behave like them The pathologist should be informed concerning the age of the in dividual and whether or not there is evidence

of approaching puberty. These nevi show remarkable pigmentary changes with the onset of puberty in that they become much more darkly pigmented and have a tendency to become elevated above the level of the skin. Pack's experience with more than 900 cases of malignant melanoma has been that none of these melanotic tumors of infancy and childhood have metastasized to regional lymph nodes.

It is suggested that the malignant melanoma, in its derivation from the pigmented nevus, is closely related to the endocrine system. Malignant melanoma occurring just after puberty and during pregnancy shows extremely rapid growth and wide dissemination.

Discussing the relation of trauma to melanoma, the author mentions the frequency of melanoma on the soles of the feet in natives of the Sudan, attributed to injury from an irritating thorn. Case histories in this country would seem to suggest that repeated irritation of moles may be a factor inducing malignant change.

It is not always possible to observe the transformation of a pigmented nevus into a malignant melanoma clinically. When a pigmented mole undergoes certain changes, such as becoming more elevated, with increased pigmentation, or with ulceration, bleeding and localized discomfort or pain, that tumor may be becoming malignant. If a pigmented mole is completely removed during its benign state, it never recurs as a melanoma. Every pigmented mole that is excised should be submitted for microscopic study. Surgical excision is the only appropriate treatment for pigmented nevi and malignant melanoma. These tumors are notoriously resistant to irradiation.

Excision and dissection in continuity are advised for primary and metastatic melanoma in regional lymph nodes. By this means, not only are the primary tumor and the first relay of metastases in regional nodes removed, but the intervening lymphatics as well. In the past 15 years, 5-year survivals without recurrence have increased 600 per cent. Pack believes that this improvement can be attributed entirely to the adoption of the principles of radical surgical therapy as outlined in this article.

Erich, J. B.: Extensive Epithelioma of the Buccal Surface of the Cheek: Report of a Case. *Am. J. Orthodontics 33:* 607, Aug. 1947.

According to Erich, malignant tumors of the buccal mucosa are usually squamous-cell epitheliomas. A few are highly active but the majority grow rather slowly and are graded Broders' I or II. Tuberculous, syphilitic, Vincent's and other inflammatory ulcerations must be considered in the differential diagnosis.

Cervical metastasis can occur early even though the primary lesion be rather small and low grade. Grade I epithelioma is not likely to involve the regional lymph nodes, provided the local lesion has not been traumatized or inadequately treated. This is particularly true in middle-aged and elderly persons.

Low-grade epitheliomas are not radiosensitive. For this reason the author favors surgical treatment. For extensive cancers and recurring tumors, electrocoagulation is the method of choice.

For highly active lesions, which are extremely radio-sensitive, irradiation should supplement surgical measures. The major portion of high-grade epitheliomas may be destroyed by surgical diathermy and by inserting radon seeds throughout the electrocoagulated base.

Unless the local lesion is very small and very low grade, a block dissection of the cervical lymph nodes should be done. In Grade IV epithelioma external radiation applied to the neck is preferable to surgical measures.

A case of extensive epithelioma involving the left cheek is reported. The lesion was Grade I and no nodes were felt. Dissection of the nodes was not done. The entire cheek was removed by surgical diathermy with destruction of a small amount of maxilla and mandible. Eight months later reconstruction was carried out, a tube from the side of the chest being used. No recurrence was seen after 2 years.

MISCELLANIES

Barker, D. E.: Late Results in Surgery for Decubitus Ulcers. *Am. J. Surg. 74:* 180, Aug. 1947.

A report on 80 cases of surgical repair of decubitus ulcers is given by Barker. Twenty of these patients have been observed for one to 12 years following surgery.

On the whole, the results by excision and closure and by the use of flaps have been excellent. Grafting, however, should be reserved for patients who are in such poor clinical condition that extensive surgery and blood loss would be contraindicated, for ulcers which have been grafted will ultimately break down.

McEvitt, William G.: The Problem of the Protruding Ear. *Plast. & Reconstruct. Surg.* 2: 481, Sept. 1947.

The anatomy and embryology of the ear are reviewed by McEvitt and the etiology of protruding ears is discussed in detail. A classification of protruding ears is advanced, and the three types making up this classification are well illustrated with photographs.

The operations designed to correct the protruding ear are discussed under two subdivisions: I. Methods designed to bring the entire ear closer to the head. II. Methods designed to produce a normal antihelix. The operations in Group I are mentioned as being of historical interest only It is observed that Luckett first made note of the failure in development of the antihelix in patients with protruding ears as early as 1910, and surgical procedures based on his observation improved results greatly.

McEvitt believes that any of the various operations in Group II based on Luckott's fundamental concept produces acceptable ears. Generally speaking, however, it is unnecessary to use mattress sutures, Lembert sutures, gauze bolsters, and special materials such as stainless steel wires if the cartilage of the ear has been adequately measured and adjusted. A detailed description of the author's own surgical approach to the problem is given, with illustrations to indicate the steps. An ellipse of skin is excised from the posterior surface of the ear, and a new antihelix constructed following an outline previously drawn in methylene blue. Excision and incision of ear cartilage or both are made as indicated. Parallel incisions are frequently made for measuring. Cartilage suturing is always necessary when no cartilage is removed but otherwise is optional. A light dressing is applied as a turban for 4 days, followed by placement of gauze strips held with adhesive tape.

Editorial Comment: There is little that is new in this article about the correction of so-called "lop ears" or "protruding ears." However, it is a good summary of the surgical history and present-day knowledge relating to this problem.

NASAL DEFORMITIES OF SYPHILITIC ORIGIN

V H KAZANJIAN, M D.

Deformities of the nose from syphilitic ulceration may be slight or extensive, depending upon the amount of destruction that has taken place They have a special appearance all their own, and are distinguished without difficulty from traumatic deformities Syphilis seems to attack the mucous membrane of the nose and gradually spread to the cartilaginous and bony framework Eventually the septum as well as the turbinates may be destroyed, and the entire nasal cavity is covered with dense scar tissue The degree of deformity is proportionate to the loss of supporting substance In a mild case, one sees a slight depression of the dorsum of the nose due to loss of cartilage and contraction of scar tissue of the inner lining, in an extensive case, the lower half of the nose may become a shrunken mass with distorted nostrils In some cases, part of the wing of the nose and columella may be destroyed It is not unusual to find the lip pulled upward, thus intensifying the deformity In cases under observation, by the author, the deformities were mainly due to destruction of the cartilaginous framework of the nose and the inner lining There is rarely any loss of skin covering or destruction of the nasal bones (Fig 1)

METHODS OF TREATMENT

A Mechanical Devices Prior to the introduction of surgical methods, mechanical devices were used to raise the nose If the patient had a palatal perforation, it was comparatively easy for a dentist to construct a denture with prolongations on the nasal surface to raise the nasal bridge Some ingenious appliances have been devised by Claude Martin (1), Kingsley (2), and others It is apparent that such support has only limited use, owing to lack of elasticity of the scars covering the entire surface of the nose In order to given internal artifical support and nasal contour, Gillies (3) advocated restoring the inner lining of the nose by a skin graft, held in position by special splints fastened to the anterior teeth

The writer also used mechanical supports to maintain nasal contour in his patients during the First World War In one particular case the patient had lost the greater part of the hard palate, upper lip, and septum of the nose Before plastic procedures were begun for the repair of the upper lip, an appliance was made to cover the palatal defect, with extension of its nasal side to support the lower part of the nose With such extensive traumatic deformities, prosthetic devices may be justified in certain instances Syphilitic deformities, on the other hand, are due primarily to loss of mucous membrane and cartilage of the nose, and sufficient inner lining and support to give the skin a normal contour can be supplied without resorting to prosthetic devices

The operative procedure varies in each case, according to the degree of deformity—amount of nasal tissues available for reconstruction Consequently,

no set rules can be given. The following case histories are offered as examples of general types of procedure which may be modified in detail as the condition requires.

FIG. 1. Photographs showing nasal deformity of luetic origin. Note the marked retraction of the upper lip and shrinking of the lower half of the nose.

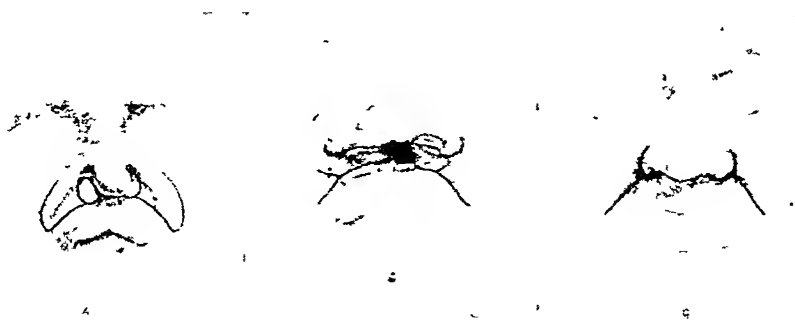

FIG. 2a. Diagrams (Case I) showing the incision lines around the wings of the nose After cutting through the adhesion, the skin of the nose expanded to normal size. The lateral incision lines are outlines of the flaps which made the inner lining of the nose as seen in figure 2b.
FIG. 2c. Final suture lines after cutting through the pedicles of the naso-labial flaps.

*Case History No. 1.** This patient had a sore on the side of the nose which gradually developed into extensive ulceration. Under specific treatment the ulceration disappeared, but it left the nose in a deformed condition (Fig. 1). Examination revealed the lower part of the nose collapsed, mainly because of the destruction of the septum and mucous membrane. The columella was missing and also the lower part of the alae of the nose. The

* Published in the Transactions of the American Academy of Ophthalmology and Otolaryngology. 1937.

upper lip was retracted by the scars The plan adopted for this case was to restore the inner lining of the nose and to repair the columella

Fig 3 Final photographs (Case I) The supply of skin flaps from the naso labial area was sufficient to give the nose normal appearance

Fig 4 Pre operative photographs (Case II) The lower half of the nose has shrunken, due to contracture of mucous membrane and loss of cartilaginous support

The patient was operated on under general anesthesia An incision was made along the side and base of the nose, and the skin was freely separated from the underlying adhesions Undermining was carried above the nasal bones (Fig 2a) Tongue shaped flaps were prepared from the side of the face following the nasolabial lines (Fig 2b) and folded in to cover

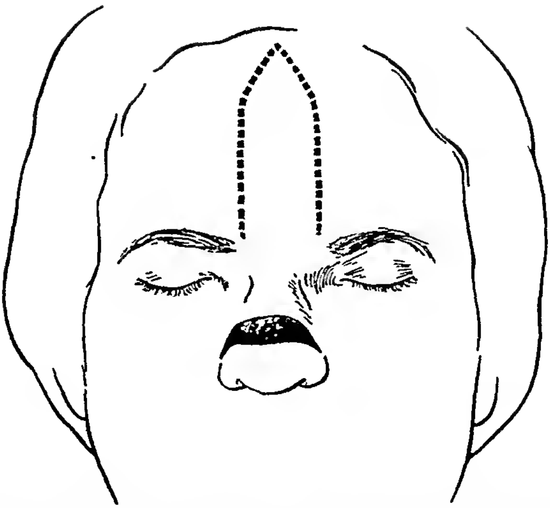

FIG. 5. Outline of median flap. Incision was made just below the nasal bones and nasal cavity was entered. All adhesions within the nose were cut through until the skin at the tip was relaxed.

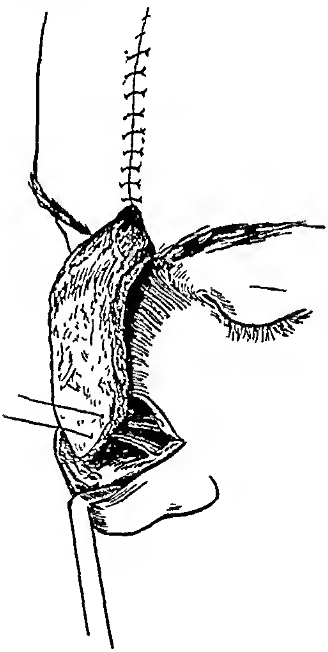

FIG. 6

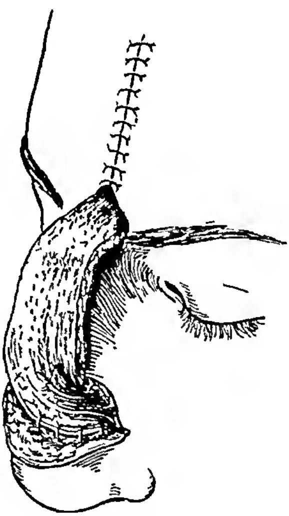

FIG. 7

FIG. 6. The first stutures of the median forehead flap. The skin is turned in to form the inner surface of the nose.

FIG. 7. Diagram shows the end of the forehead flap sutured to the edges of the inner lining of the nose. The exposed raw area of the flap is covered temporarily with skin graft as seen in Fig. 8.

the raw surface under the skin of the nose. Fourteen days later the second operation was performed. The base of the flap was cut in order to suture the alae of the nose in proper position (Fig. 2c). Eventually, the columella was reformed by borrowing a section from

FIG 8 Photograph of patient (Case II) Skin surface of the forehead flap turns in to form the inner surface of the nose Exposed raw area is temporarily covered with skin graft.

sutured over the frontal emmeence The
to cover the sides of the vestibule Skin

the median line of the upper lip The restoration of the inner lining of the nose with flaps from the sides of the face gave sufficient contour of the nose making further operation unnecessary (Fig 3)

FIG 10. Photograph showing skin covering of the nose; after the forehead flap had been sutured to form the inner surface of the nose

FIG. 11. Final photographs of patient (Case II) Iliac bone graft had been inserted for the improvement of the contour of the dorsum of the nose

While the procedure employing lateral flaps gives satisfactory results in experienced hands, the median forehead flap repair of nasal defects is a more reliable procedure and more uniform results can be expected The operative procedure in the following case history follows the principle of the Nélaton and Ombrédanne operation, but differs in details

Case History No 2 This 35 year old female had an infection of the nose in childhood Since then her nose had remained depressed (Fig 4a & b) Examination showed the nasal bones to be of normal contour, but all the cartilages of the lower half of the nose were absent, the bridge was depressed, the vestibule contracted, the tip was a small button of tissue, the septum was entirely destroyed, and the upper lip was retracted upward There was no history of tuberculosis The Hinton test was negative, but there was a strong suspicion that the ulcerative lesion she had in childhood was probably due to congenital syphilis Operation was performed under two per cent novocain injection over the forehead as well as over the skin of the nose An incision was made over the dorsum, just below the nasal bones, following the sunken line in back of the wings of the nose The nasal cavity was entered All the adhesions of the mucous membrane were cut through until the lower part of the nose became loose (Fig 5) A median forehead flap about one inch wide was then raised, folded down, and sutured to the mucous membrane of the tip of the nose the skin surface forming the inner lining (Fig 6, 7) The raw area of the forehead was closed The exposed raw surface of the flap was covered temporarily with a skin graft (Fig 8)

Thirty three days later the next operation was carried out under novocain anesthesia the previously formed forehead flap was severed at its proximal end and replaced over the frontal eminence The adhesions of the vestibule were cut to release the skin of the nose and the resulting raw area was covered by the remaining part of the forehead flap Thus the forehead flap supplied the entire inner lining of the nose (Fig 9) The opening of the dorsum of the nose was closed by joining the skin edges (Fig 10)

Following these two operations, the patient had a third operation, a transplantation of bone over the dorsum of the nose was performed by my colleague Dr Edgar Holmes seven months later (Fig 11)

SUMMARY

Two surgical procedures are presented here for the correction of nasal deformities from luetic infection Both are based on the principle of supplying lining of the nose One type is treated with a skin flap from the forehead, and the other with a flap from each nasolabial line Clinical results of both types are good, but I am inclined to think that if the patient has a moderately high forehead and loose enough skin to close the gap by approximation of the borders, the median scar eventually becomes invisible

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WET DRESSINGS IN PLASTIC SURGERY

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AND

ALLYN J. McDOWELL, M.D.

The value of wet dressings in infected wounds has long been recognized. However, the methods of employment and the results presented here differ sufficiently from the conventional use of wet dressings to warrant presentation. The wet dressings described have been used on a large number of free skin grafts, pedicle flaps, composite grafts and wounds with severe lacerations and interference with blood supply. The results, we believe, are definitely superior to those obtained in similar wounds where the former type of wet dressings had been used. We are aware that the variations in technique described here may seem small but they have proved to be of value.

MODE OF ACTION

Presumably a wet dressing promotes growth and healing in the presence of infection by:

(1) The preservation of any microscopic blood vessels which because of their tiny caliber cannot tolerate the trauma of short exposures to dry air, or incorporation by a dry crust or clot; often the ordinary vaseline dressing may have a destructive effect.

(2) Increasing the absorption of exudates from within the wound into the dressing by dilution and subsequent capillary attraction, which depends on a continuous layer of fluid.

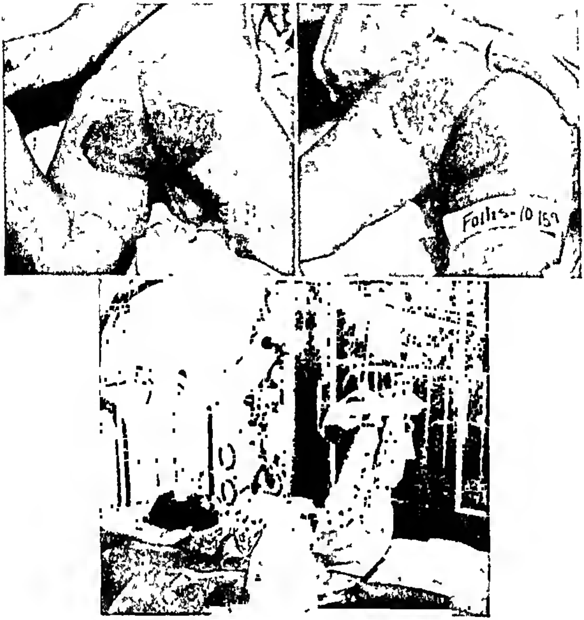
(3) Preventing the formation in the wound of clots and crusts which tend to dam up secretions and blood with consequent lysis of tissue due to infection, pressure and loss of blood supply.

All of the above factors are dependent upon the constant contact of every part of the wound with a continuous layer of fluid. The commonly employed wet dressing will often offer only a damp layer of gauze which cannot effect any of the above conditions.

INDICATIONS

Wet dressings have been used in a series of severely lacerated and contused flaps secondary to traumatic injuries of extremities with much greater success than formerly when either vaseline-based preparations or inadequate amounts of solution were employed. Wet dressings are futher indicated in open and infected wounds and as a post-operative dressing whenever skin grafting is done on a base with relatively poor blood supply, such as fat or bone. The use of this dressing post-operatively on skin grafts where healed and closed areas are repaired has greatly enhanced the likelihood of a complete take.

In severe wounds of the extremities the direct trauma to the tissues and ische-



A B C

FIG. 1

Case I, D. F.: A one-year old boy was admitted with third degree burns of both buttocks sustained one month previously when he was placed in a pan of hot water. Treatment had [illegible] on admission, showing redundant granulations [illegible] taken completely following excision of [illegible] Patient discharged completely healed [illegible]

mia secondary to vasospasm or thrombosis may both contribute to ensuing necrosis of tissue. Here, the use of wet dressings with an electric fan directed constantly on the dressing decreases metabolic demands by partial refrigeration in

addition to the other benefits of the wet dressing. By supplementing this treatment with frequent sacral or brachial plexus blocks to combat vasospasm and thrombosis, we feel that we have saved considerable amounts of tissue which would otherwise have been lost.

Fig. 2

Case II, K. W.: A three-year old girl was admitted on 11–30–47 with dirty, granulating areas of anterior chest, abdomen, arm, chin and neck following third degree burns sustained three weeks previously when clothing caught fire. Treatment elsewhere consisted of grease dressings and systemic supportive measures. Her general condition was fair with a hemoglobin of 82%. A pre-operative transfusion of 250 cc. of whole blood was given and a second such transfusion was given at the time of surgery. After preparation with wet dressings for three days skin grafts were applied and wet dressings continued.

Grafts are shown on the fifth post-operative day with a complete take of the grafts applied. Four dermatome drums of skin were grafted at the initial operation and the remaining grafting was postponed in view of the patient's general condition. The remaining raw areas shown were all subsequently grafted at a second operation three weeks later and the patient was discharged healed on 1–17–48, forty-eight days after date of admission.

In any wound in which the survival of tissue depends on an embarrassed blood supply, the use of wet dressings seems clearly indicated. When considerable bleeding has occurred beneath a graft, as may happen following the use of a tourniquet, the protracted use of wet dressings post-operatively for as long as two to three weeks can result in the saving of a graft which would otherwise undoubtedly be lost due to the underlying hematoma.

METHOD OF APPLICATION

The post-operative dressing on skin grafts applied to contaminated granulating surfaces has in our experience provided the most frequent indication for a wet

Fig. 3

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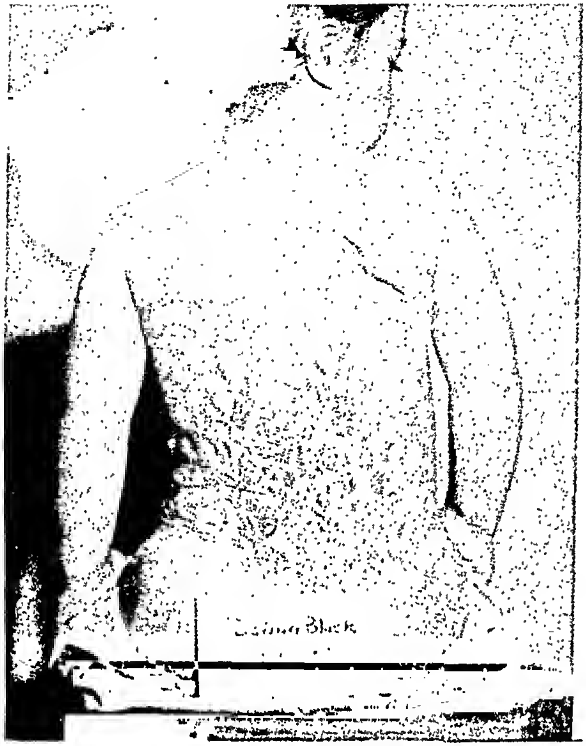

B

dressing and such a wound can therefore be used as a typical example in describing its application

When the graft has been completely sutured in place, all blood accumulated beneath the graft is expressed and the dressing immediately applied As a rule the graft is pie crusted The graft is first covered with smooth unfolded gauze flats so that only one or two single layers of gauze cover the graft Irrigating catheters are then laid in place over this gauze Even the thickness of one ordinary folded gauze flat beneath the catheters may cause absorption of the fluid by the overlying dressing and prevent full contact with the grafted area The catheters, which may be old #16–#20 urethral catheters with extra holes cut in them, are spaced about two to three inches apart They are then covered with several layers of moistened gauze sponges and one or two layers of abdominal pads or mechanic's waste This entire dressing is then tied snugly in place over the graft by means of heavy silk sutures placed in the skin margins about the periphery of the wound, in some wounds on extremities the dressing may be wrapped in place, but if any remote danger of displacement of the dressing exists the security of the tied on dressing is well worth the added effort This entire dressing is then supplemented with an outer dressing again using abdominal pads or mechanic's waste wrapped on securely with stockinette bandages The use of cellophane, oiled silk, rubber sheeting or other impervious materials is avoided since it appears to promote the growth of pyocyaneous and other infections Conversely, gauze rolls and gauze bandages are so porous that the dressing dries out with great rapidity

After this initial application the success of the dressing depends on keeping it constantly and thoroughly saturated with solution An inadequate amount of solution at any time may defeat the entire purpose of the dressing, while excessive quantities *do no harm* The amounts of solution necessary will vary, particularly with the temperature and humidity of the area We find that in dry southern California, with the catheters spaced about two to three inches apart, three ounces of solution injected into each catheter every two hours day and night

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Fig 1

Case IV, D B A four year old girl was admitted with deep scar contractures resulting from third degree burns of trunk sustained 18 months previously and treated elsewherer The entire chest and abdomen were completely circumscribed by a heavy and inelastic sca

deeply scarred muscle and thinly covered bony prominences The graft was dressed as

B Grafts on the sixth
areas of hematoma beneat
toma was absorbed with a
tomata beneath grafts A
with considerably less restriction of respiratory motion Donor sites were limited and further grafting of the remaining scar covering is planned

A

B

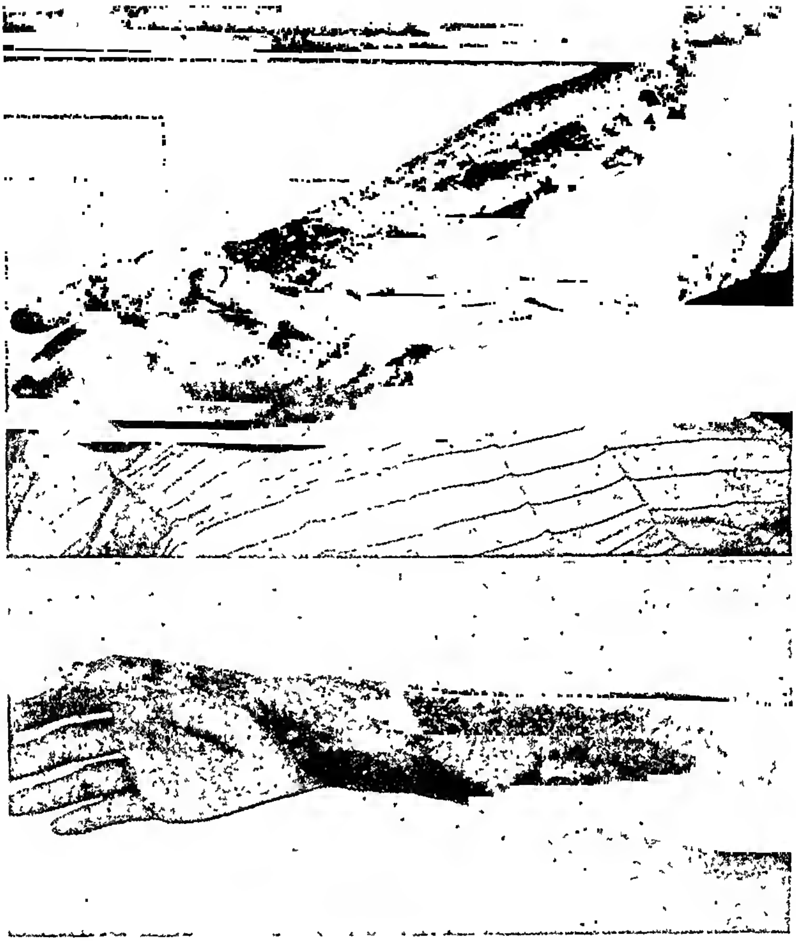

FIG. 5

Case V, B. V.: A twenty-two year old man was admitted on 1–3–48 with third degree burns of both forearms and hands, sustained three weeks previously and treated elsewhere with grease dressings. The granulations were dirty but the patient's general condition was good. After preparation with wet dressing for 48 hours, the involved areas on the right forearm and hand were excised down to a base of normal subcutaneous tissue and skin-grafted. A tourniquet was used during the dissection, then released and all visible bleeding points were tied before application of the grafts. Post-operative bleeding occurred beneath the grafts but with the prolonged use of wet dressings post-operatively, all of the grafts survived.

A: The extent and condition of the involved areas on admission are shown. The left hand was not grafted due to the small area of true third degree loss.

B: The intact and healed grafts are shown six weeks post-operatively. The first dressing on the fourt post-operative day revealed extensive hematomata of 2 to 4 millimeters thickness beneath most of the grafts with one hematoma measuring approximately 4 by 12 centimeters. Wet dressings were continued for a total of two weeks during which time the hematomata absorbed and all of the grafts survived. Patient was discharged with all areas healed on 1–30–48, 4 weeks after hospital entry.

usually will be adequate; but in hot dry weather this amount may be doubled. It is the natural tendency for nurses to inject only the amount ordered or even less as soon as the dressing begins to soak through. It is important to impress

on all attending personnel that the dressing be kept constantly and thoroughly saturated with fluid and that no harm can come from any surplus amounts. Moreover, it is worth stressing the written order by underlining. Instructions should also be given to inject supplementary amounts of fluid directly into the dressing in any instance where the catheters do not appear to wet sufficiently the entire area. We use a $2\frac{1}{2}\%$ boric acid solution routinely as an irrigating medium since it has proved to be safe and effective and its pH seems helpful to combating pyocyaneous infections. However, normal saline or Ringer's solution may give quite satisfactory results. We have often used alternate injections of acetic acid solution ($\frac{1}{2}$ to 1%) in cases where previous pyocyaneous infections existed.

The use of adequate amounts of solution to soak the dressing properly will naturally result in an overflow onto the bed. Rubber sheeting to protect the mattress and the rest of the body will add to the comfort of the patient, but despite the wet bedding we have not had a single case of pneumonia or other respiratory infection that could be attributed to the use of wet dressings. Nor does the patient's reaction to this enforced discomfort constitute a problem in his care; we take time to explain carefully the reason for using this type of dressing and enlist the patient's aid in helping to see that the solution is adequately and properly used. No maceration, desquamation or skin irritation results either to the graft or the surrounding skin from keeping the graft in this fluid medium. The wet dressing is continued for about four to eight days post-operatively in average cases and for whatever additional time is necessary, so long as the hazards of infection or necrosis of tissue exist. Where the recipient area has a poor blood supply a longer period is preferable.

In composite grafts to the nose, chances of a "take" are enhanced by keeping the dressing wet by moistening with a syringe. Here, because the dressing is small and evaporation may be rapid, the patient maybe instructed how to keep it moist since hourly wetting is often necessary.

In some dressings about the face and in other instances, where the use of a true wet dressing is deemed somewhat impractical, a worthwhile substitute may be found in the use of a dressing initially saturated with a mixture of equal parts of 70% alcohol and glycerine. The hygroscopic properties of such a compress are such that it will usually remain moist for two or three days with no additional moistening. With proper precautions to protect the eyes from the alcohol, this dressing may even be used on grafts about the lids.

We feel from our own experience that inferior results in the use of wet dressings will occur from any of these common errors: (1) Poor placement of catheters and inadequate wetting of all involved areas; (2) the inclusion of too many layers of gauze between the wound and the irrigating catheters; and (3) the inclusion of impervious membranes in the dressing.

RESULTS

By employing wet dressings in this manner, results have been obtained in the face of infections and poor blood supply that we have not been able previously to obtain by any other of the more common dressings. Old third degree burns that when first seen are grossly infected and dirty from weeks or months of improper

care can often be grafted successfully within three or four days with no other preparation than the application of wet dressings and correction of any existing anemia with blood transfusions. This program does presuppose the complete excision of the granulating surfaces and scar base down to normal tissue at the time of operation, and the application of relatively thick grafts on such a base in order to ensure the maximum amount of elasticity and function in the ultimate result. Continuing the wet dressing for seven to ten days post-operatively routinely results in a complete take of the grafts in such cases without pockets of pus beneath the graft, blistering, hematoma or other difficulties which can lead to spotty or large losses of grafts with mediocre or poor results. We use the term "complete take" to mean 98–100% of the skin grafted despite the fact this term has been used to denote anything from an adherence of 60% of the graft upward. The occurrence of hematoma or infection with the loss of areas the size of a five-cent piece or larger should and can be avoided.

RECONSTRUCTION OF THE THUMB

By Transposition of an Adjacent Digit

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AND

J. WILLIAM LITTLER, M.D.†

Loss of the thumb constitutes a disability of such magnitude that some type of reconstruction is usually indicated, even though the affected hand is not the dominant one. Should the entire first metacarpal be preserved, a simple and reasonably satisfactory improvement consists of phalangization of the metacarpal and lining of the cleft with a combination of adjacent skin flaps and free grafts.

In the event that part or all of the first metacarpal has been destroyed, reconstruction becomes more complicated. Reported methods fall into three general groups. A frequently described procedure, applicable also in the case of an intact metacarpal, consists of the application of a tubed pedicle flap to the thumb stump, reinforced later by a tibial or iliac bone graft. This type of repair has the obvious disadvantages of rigidity and poor sensation.

The second group consists of the transplantation of a digit from the opposite hand or from a foot. We have had no personal experience with this procedure but believe that any toe is unsuitable as a substitute for a digit and that the transplantation of a finger from the opposite hand, necessitating the union of bone, tendons and nerves in addition to complete revascularization of the digit, affords so many technical difficulties and possibilities for failure that its employment in thumb reconstruction should be very cautiously weighed.

The third method employs the transposition of an adjacent digit into thumb *position. We consider this procedure definitely superior to the preceding one* inasmuch as the continuity of vessels, nerves and tendons is preserved and the operative procedure simplified considerably. Numerous authors have described this type of thumb reconstruction, utilizing local skin flaps, with or without supplementary free grafts, to cover the created defect (1, 5, 6, 8, 11, 19, 20, 22, 23, 27, 28, 29). In the majority of these cases the deficiency of available skin has imposed limitations of function but occasionally very serviceable reconstructions have resulted.

In several instances a digit other than the one most adjacent to the damaged thumb has been employed (12, 14, 17, 22, 24). Usually the proximal phalanx has been sacrificed and the middle and distal phalanges carried to the first metacarpal stump on a soft tissue pedicle. Such a procedure might be applicable when the first metacarpal is of nearly normal length but would almost certainly fail to give adequate opposition in cases of extensive loss of the first metacarpal.

To supplement the usual deficiency of local tissues for resurfacing after the transposition of an adjacent digit or ray, Dunlop (4) in 1923 reported the use of

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an abdominal pedicle flap to fill the cleft and a similar procedure was reported subsequently by Kelikian and Bintcliffe (13) and Parin (22).

During our four years of military experience in the care of hand injuries we have had occasion to complete seven cases of transposition of an adjacent digit. In five of these cases an abdominal flap was necessary to afford proper position for the transposed digit. One case in which the skin was exceptionally soft and pliable was closed by a dorsal Z-plasty and in another a pedicle flap of skin from an amputated digit was utilized. Although in each instance we have used a ray which has been damaged by the original injury we feel confident, in the light of this experience, that a normal digit can be justifiably transposed in selected cases and will give results superior to the other methods previously discussed.

A satisfactory reconstruction of the thumb should meet these critieria. (1) It must have sufficient forceful flexion and extension to permit grasping. (2) The tip of the reconstructed digit must be opposable to the pulp of at least one and preferably two adjacent digits. (3) The tip must have some tactile sensation, otherwise much of its usefulness is lost. (4) Less important but nevertheless desirable is an inconspicuous appearance and a reasonable reproduction of thumb contour. This paper is presented with the intention of standardizing an operative plan which will fulfill these requirements. We postulate a thorough understanding of orthopedic and plastic principles applicable to hand surgery as an essential to its success.

I. PRELIMINARY PREPARATION OF THE DAMAGED HAND

A detailed discussion of the immediate treatment of hand injuries is not within the scope of this paper. Yet one should mention the importance of early mobilization and prompt coverage of the wound by free graft or, if necessary, by pedicle flap. Occasionally primary or secondary suture may be employed, but usually the amount of skin loss is such as to preclude this possibility.

Thumb loss is usually a part of more extensive trauma including carpal disruption, extensive soft tissue loss, and loss or injury of adjacent rays. The one condition which definitely contraindicates the transposition of an adjacent digit is inadequate circulation. The latter should be carefully evaluated and any major procedure deferred until satisfactory nourishment is evident. Vasospasm may be reduced by dorsal sympathetic block or sympathectomy. Other impairments need not cause undue concern. Metacarpal fracture is insignificant since sufficient length can be obtained with the phalanges alone. Damaged flexor or extensor tendons may be replaced later by transplants and anesthesia can be corrected by secondary nerve suture, taking advantage of the shortening of the transposed digit to obtain approximation.

A preliminary revision of scars is usually necessary. Any significant scar at the site of thumb loss should be excised in order to improve circulation to the base of the adjacent digit since the neurovascular bundle on the radial side is frequently destroyed. If the size of the scar prevents primary closure the defect may be filled by an abdominal pedicle flap. In our series we have used direct flaps for this purpose. However, it is quite feasible to implant a tubed pedicle

flap into such a defect, utilizing the detached end later to fill the cleft at the time of transposition

At this time it is desirable to transplant any intact extensor tendon (or both extensor tendons in case the index finger is used) to the dorso radial aspect of the metacarpal (see Case II) The purpose of this step is to have the extensor tendon out of the operative field when the transposition is later effected As will be seen, the presence of this tendon in its usual position constitutes a vulnerable spot in the transposition procedure and led in one of our cases to the actual loss of the tendon (Case IV)

If the digit selected for transposition presents a sensory nerve deficit one may find it possible during a preliminary scar revision to perform a direct nerve suture of the divided segments or of a distal segment to one of the thumb branches

II TRANSPOSITION OF THE DIGIT

In the usual case in which the second ray is to be transposed a longitudinal incision is made on the dorsal aspect of the hand between the second and third metacarpal bones, extending from the metacarpal bases to the interdigital web and thence onto the volar aspect of the hand to the mid palmar crease If the extensor tendons have been previously transplanted they will not be encountered at this time, otherwise they are freed and retracted radially after dividing the junctura tendinum As the dorsal incision is deepened the second dorsal inter osseous muscle is separated from its attachment to the second metacarpal, leaving intact its attachments to the third ray The intermetacarpal ligament is divided and the metacarpal bones allowed to diverge, the first volar interosseous muscle being carried with the second metacarpal The digital nerves and vessels are exposed during this maneuver The digital branch of the median nerve to the index and middle fingers usually bifurcates near the proximal aspect of the incision but may be split if necessary The proper volar digital artery to the radial aspect of the middle finger is transected, particular care being exerted to protect the branch to the index finger inasmuch as it may be the only intact volar artery to the digit (Fig 1)

The metacarpal is transected through mid shaft unless a previous fracture has determined the line of division Sufficient mobilization is then obtained to rotate the digit into thumb position One has the choice of allowing the meta carpal to lie free in its new site or of fusing it We prefer the former since it is exceedingly difficult to obtain and maintain proper opposition at this stage If a sizable segment of first metacarpal remains, one may fuse it directly to the rotated metacarpal segment (or in its absence to the proximal phalanx), fixing it with Kirschner wires or with an intra medullary bone peg

At this stage a large wedge shaped defect presents itself between the transposed ray and the adjacent metacarpal The new thumb is allowed to roll under the fingers and the hand is brought onto a superior quadrant of the abdominal wall where a pedicle flap is laid out with a cellophane pattern, the base directed superiorly The flap is dissected below the deep layer of the superficial fascia inasmuch as bulk is desired to fill the defect A centimeter or two of the margin may be thinned to facilitate apposition

If the extensor tendons have been displaced at a previous stage they will not be encountered at this time, otherwise they will lie across the field and will interfere with proper placing of the pedicle flap. This situation can be obviated by displacing the tendons radially into a subcutaneous pocket where they are transfixed by a removable wire suture.

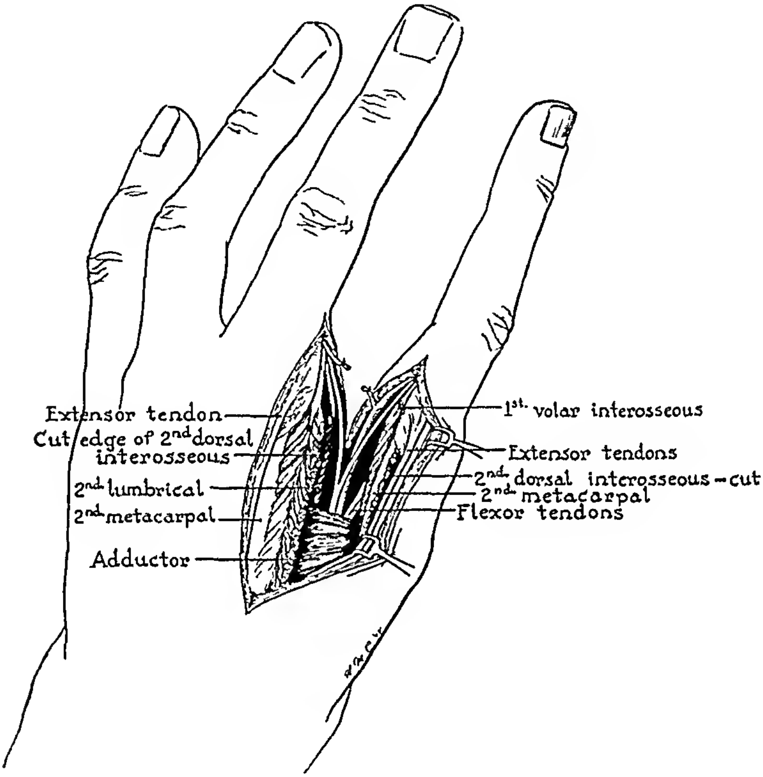


FIG. 1. Usual operative approach for mobilization of an index finger to replace the thumb. Following this step, the extensor tendons of the index finger are drawn under the skin flap and anchored with a removable wire suture. The second metacarpal, if not already fractured at the time of injury, is transected and the index finger moved into thumb position.

The defect on the abdominal wall is closed by undermining or by free grafts and the pedicle flap brought over the dorso-radial aspect of the hand and implanted in the cavity. A particular point is made of bringing a broad, rounded corner of the flap well down into the palm of the hand without tension. Marginal losses in this area or an insufficient palmar incision will limit abduction of the reconstructed digit.

The flap is let into the defect dorsally because it permits more complete application and allows the reconstructed thumb to fall into a natural position. In one instance (Case III) we applied the flap from the volar side but the method was not used further because of the flattened position assumed by the transposed digit.

A vulnerable feature of this stage is the difficulty in carrying the pedicle flap into the deepest recesses of the wedge-shaped defect Small hematomata were consistently noted in this area when the final insertion was carried out and in one instance (Case IV) an actual abscess developed To reduce this risk the following modification is used (Case V) A fluffed gauze pack is carefully pressed onto the flap to eliminate the underlying pocket and maintained in position by a mattress suture carried through pack, flap and palm of hand and tied over buttons

Finally the hand and flap are carefully packed in fluffed gauze and immobilized by adhesive strapping The detachment and insertion can be carried out in one stage after three weeks although we have usually allowed several days to elapse between these two steps.

III. POSITIONING AND ACTIVATION OF THE TRANSPOSED DIGIT

Because of its functional importance we prefer the proper positioning of the transposed digit as a separate operative step Fixation of the transposed digit to the carpus in a functional position may be done directly or by means of a bone graft If satisfactory contact can be made between metacarpal or proximal phalanx and carpus, position is maintained with Kirschner wires and direct union results However, it may be necessary to bridge a gap between carpus and digit with a bone graft The latter is fused to the proximal phalanx, thus eliminating the metacarpo phalangeal joint, and final position of the digit is determined by the carpal fusion If sufficient first metacarpal stump remains, it is fused to the proximal phalanx of the transposed digit The thumb in functional position can be considered as an extension of the radius and is placed so that the terminal phalanges of the fingers converge upon its terminal phalanx From this point of "maximum pinch", extension and flexion permit a wide range for grasping

Some shortening of the transposed digit is essential if it is to function effectively as a thumb, and if it is rigid the shortening must be considerable The active amplitude of intact extensor and flexor tendons may be jeopardized if too much recession occurs When considerable shortening is desired it is feasible to amputate the terminal phalanx of the transposed digit (Case IV and VII), thus preserving tendon amplitude, giving more effective control to the digit and providing a full rounded tip

If the transposed metacarpal is fused to the carpus leaving the metacarpo phalangeal joint intact, hyperextension of this joint and compensatory flexion of the inter phalangeal joints may result Normally the intrinsic muscles maintain flexion of the metacarpo-phalangeal joint, but when the metacarpal is shortened and rotated their function is impaired Correction of this deformity is achieved either by a fusion of the metacarpo phalangeal joint in a functional position or by a tendon transfer to stabilize the joint If terminal phalangeal flexion persists the phalanx may be amputated or the distal phalangeal joint may be fused in a functional position

In case of flexor tendon loss a free graft or a transferred ring sublimis tendon will provide flexor function Loss of the extensor tendon necessitates the use

of a free graft. In the normal thumb the long extensor functions also as an adductor, hence restoration of this tendon provides some lateral stability of the transposed digit.

In the presence of a mobile metacarpo-phalangeal or carpo-metacarpal joint stability plus active opposition is gained by transferring the sublimis tendon of the ring finger to the proximal phalanx of the transposed finger, using the flexor carpi ulnaris as a pulley (Case IV). If the proximal phalanx is fused to the carpus such a transfer is unnecessary.

FIG. 2. Case I. Pre- and post-operative views showing rotation of index finger and fusion to first metacarpal stump in thumb position utilizing abdominal pedicle flap.

CASE REPORTS

Case I (JAB). A thirty-seven year old soldier was first seen in November 1944 following a shell fragment injury of the left hand incurred three months previously. The thumb including most of the first metacarpal was destroyed. The index finger showed a few degrees of active flexion in each joint but no extension. Sensation was present throughout. The second metacarpal presented an ununited fracture near its base (Fig. 2A).

In February 1945 a heavy scar extending from the thumb stump to the dorsum of the second metacarpal was excised and the incision extended through the interdigital web between index and middle fingers onto the palm, terminating at the mid-palmar crease. Disrupted extensor tendons to the index finger were found. The second metacarpal was mobilized in the manner described above and rotated into thumb position. The metacarpal segments were shortened to produce a digit slightly longer than the normal thumb and approximated, using two tantalum wires for fixation. The distal segments of the extensor tendons were next attached to the extensor communis tendon. A pedicle flap was outlined on the right upper quadrant of the abdomen, the base directed superiorly, and the defect in the wall closed by undermining. With the transposed digit lying in a position of oppo-

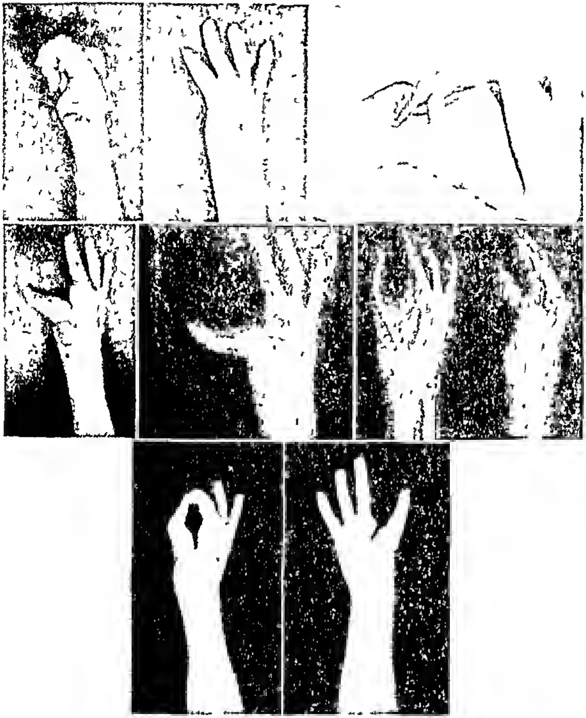


Fig 3 Case II

a. (top left) [illegible]
b. (top cente[illegible]
c (top right) [illegible] le flap
d. (center lef[illegible]
e (middle) F[illegible] fragments with tantalum wire

f (center right) Roentgenogram following fixation in position of function by tibial bone graft.

g (bottom left) and h (bottom right) Post-operative views showing function of transposed digit

sition the flap was implanted and the entire hand carefully packed with fluffed gauze and immobilized. One month later the base of the abdominal flap was severed and the insertion completed (Fig 2B). Immobilization was maintained for ten days, then graduated activity encouraged

Eight weeks later the fusion was stable, callus was demonstrable by roentgenogram and sensation was intact. The proximal phalanx could be flexed forty degrees, the distal phalanx less so. The tip of the transposed digit could be forcibly opposed to the tips of the three remaining digits. Extension was limited but permitted reasonably satisfactory grasp (Fig. 2C).

Case II (ABQ). A gunshot wound of the right hand of a Puerto Rican soldier resulted in complete loss of thumb including the entire metacarpal. In July 1945, six months after injury, thick scar covered the thumb site and extended along the dorsum of the second metacarpal which was fractured near its base and shortened. Flexion and extension of all fingers were present and sensation was unimpaired (Fig. 3A). Roentgenograms disclosed the loss of the greater multangular bone.

The scars about the carpus and dorsum of the hand were excised and the extensor tendons of the index finger found to be intact. Both tendons including paratenon were loosened from the dorsal carpal ligament to the metacarpo-phalangeal joint and displaced to the dorso-radial aspect of the second metacarpal where they were anchored (Fig. 3B). Two months later the second ray was dissected free in the manner described in the text and the distal segment anchored to the base of the second metacarpal with tantalum wire (Fig. 3E). The cleft was filled by a pedicle flap from the left upper abdominal quadrant and the defect of the abdominal wall closed by undermining the margins (Fig. 3C). Twenty-five days later the flap was detached and set in. Five weeks later the transposed digit showed excellent flexion and extension but lacked stability at its base and the digit appeared too long and insufficiently rotated (Fig. 3D).

In November the transposed metacarpal bone and metacarpo-phalangeal joint were excised, a tibial bone graft dowelled into the base of the proximal phalanx and the opposite end driven deep into the carpus. With the thumb held in a position of function a Kirschner wire was inserted through the bone graft and carpus, maintaining the digit in opposition to the middle finger (Fig. 3F). The hand and forearm were fixed in plaster for ten days, then sutures removed and a more tightly fitting plaster cast applied and retained for six weeks.

In January 1946 a review of the hand showed firm clinical union of the bone graft. The transposed digit could be flexed 80 degrees at the proximal phalangeal joint and 30 degrees at the distal phalangeal joint. Full extension was possible. The transposed digit could be abducted to form a 60 degree angle with the middle finger and would forcefully oppose the tips of the remaining three fingers. The grasp was firm (Figs. 3G & 3H).

Case III (RS). A twenty-two year old soldier sustained severe damage to the radial half of the left hand from a sniper's bullet. Examination in January 1945 three months later showed an amputation of the thumb at the metacarpo-phalangeal joint. A constricting scar covered the stump and base of index finger (Fig. 4A). Roentgenologically there was disruption of the second metacarpo-phalangeal joint (Fig. 4B). Flexion contractures of both phalangeal joints were severe and there was no sensation volarly nor on the distal half of the dorsum. The middle finger and the head of the third metacarpal were absent and the fourth ray demonstrated flexion contractures, limitation of motion and a malunited metacarpal fracture.

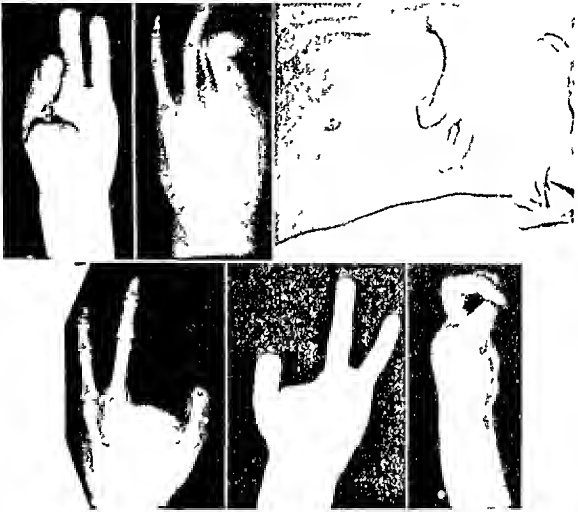
The second digit was obviously beyond hope of salvage as a functioning finger but could be used to lengthen the thumb. sacrificing the damaged middle and distal phalanges and rotating the stump to bring sensitive dorsal skin in opposition with the remaining fingers. In March 1945, five months after injury, a thick plaque of scar at the base of the index finger was excised disclosing loss of the neurovascular bundle to its ulnar side. The distal segment of second metacarpal and the associated joint were excised and the proximal phalanx mobilized and fused to the freshened tip of the first metacarpal, after rotating 90 degrees clockwise to bring its dorsal skin facing the finger tips. Fixation was maintained with tantalum wires (Fig. 4C). Four weeks later the flap was detached and set into the palm of the hand and the distal two phalanges of the index finger amputated (Fig. 4D).

To improve position an osteotomy was later carried out and the stump derotated as it was possible to suture a digital nerve branch of the transposed digit directly to a radial

nerve branch When last seen by us in October 1945 the osteotomy was firmly united in good position The new thumb could be forcefully opposed to the ring and little finger and there was evidence of nerve regeneration across the recent suture line (Figs. 4E & 4F)

Case IV (EM). A thirty six year old soldier was struck in the left hand by a sniper bullet in May 1945 Examination four months later showed total loss of the first ray and firm scar covering the amputation site (Fig 5A) Sensation was absent on the radial aspect

a b c



d e f

Fig 4 Case III

of the index finger and its proximal phalangeal joint lacked 30 degrees of full extension Roentgenograms showed additionally a fracture at the base of the second metacarpal, loss of the greater multangular and a fracture of the lesser multangular bones

Before transposing the second digit it was essential to improve its blood supply by eliminating the extensive scar In retrospect we would now use a tubed pedicle flap to resurface this defect and later utilize the free end to fill the operative cleft at the time of the transposition In actuality the scar was replaced by a small abdominal pedicle flap which was allowed to soften before proceeding with the transposition In December 1945 the cleft between second and third metacarpals was established in the usual manner, the distal frag-

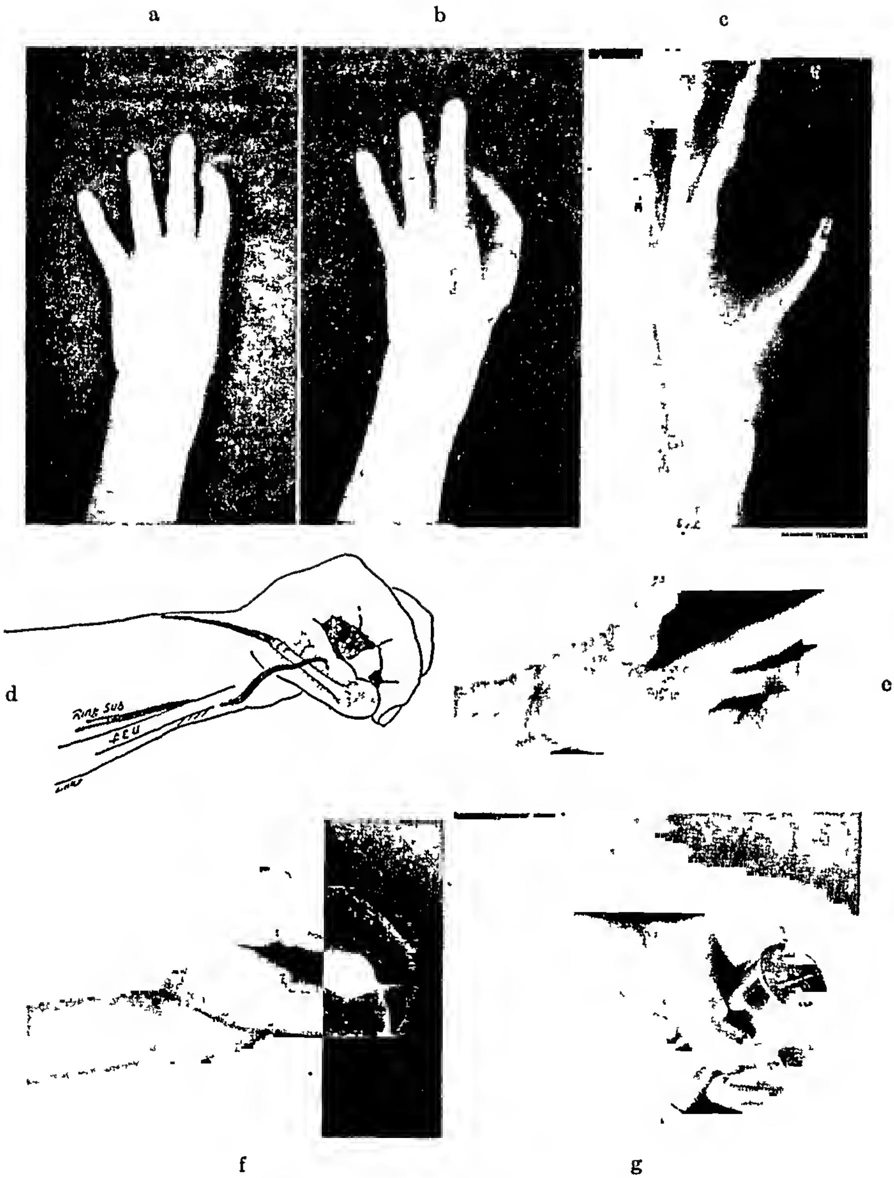


Fig. 5. Case IV

a. View showing total loss of thumb and resurfacing of original defect with abdominal pedicle flap.

b. Post-operative view following tansposition of index finger and application of second abdominal pedicle flap.

c Roentgenogram showing fusion of metacarpal to carpus and deletion of terminal phalanx.

d. Tendon graft and transfer to restore extension and to provide active opposition.

e., f , and g. Final functional views.

ment of second metacarpal shortened 1.5 cm. and impacted in the carpus. The defect was filled by a pedicle flap from the left abdominal wall (Fig. 5B).

Post-operatively an abscess developed beneath the flap and was drained dorsally. The cavity filled in rapidly but portions of the extensor tendons of the transposed finger, which

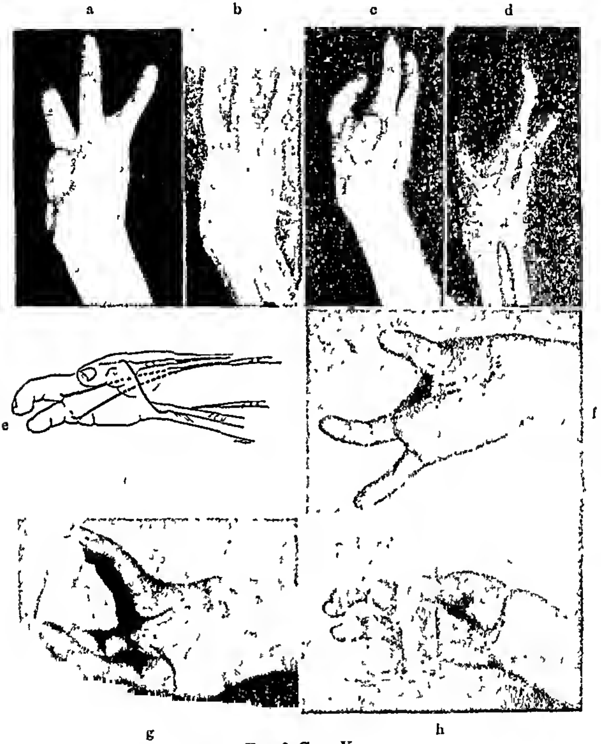


Fig. 6. Case V

lay directly across the cavity, had to be excised. The pedicle was detached and inserted in separate stages.

Post-operative evaluation of the transposed digit disclosed excessive length, incomplete rotation with non-union and lack of extension. Functional position of the mobilized index finger was gained through direct union of the distal metacarpal fragment to the carpus, maintaining position with Kirschner wires (Fig. 5C). A free tendon graft (palmaris longus) restored finger extension. Opposition was improved and lateral stability at the meta-carpo-phalangeal joint gained by transferring the sublimis tendon of the ring finger to the proximal phalanx of the transposed digit (Fig. 5D). Because of excessive finger length and loss of terminal phalangeal extension, an amputation through the distal inter-phalangeal joint was done. The end result was a digit of proper length, opposable to the middle finger and possessing adequate flexion and extension for firm grasp (Figs. 5E, F& G).

Case V (JHK). A twenty-three year old soldier was first seen in March 1946, fourteen months after a shell fragment injury of the right hand. Examination showed absence of the first and second rays, the site of amputation being covered by a soft, stable abdominal pedicle graft applied previously at another hospital. The middle finger was shortened, due to loss of its entire metacarpal, the range of motion was slight and the volar surface hypes-thetic. The ring and little fingers were intact but motion was limited. The wrist had only 20 degrees of motion and lay in marked ulnar deviation (Fig. 6A). Roentgenograms re-vealed fragmentation and loss of substance of the greater and lesser multangular bones in addition to the defects already cited (Fig. 6B).

In April the margin of the graft on the dorsum of the hand was excised and an incision extended through the web between middle and ring fingers to the mid-palmar crease. No extensor tendon was evident. The usual rotation was carried out and the proximal pha-lanx of the middle finger allowed to rest freely against the carpus. An abdominal pedicle flap was sutured into the defect in two layers. To eliminate the pocket deep in the cleft beneath the pedicle flap a bolus of fluffed gauze was placed over the flap on the dorsal aspect of the hand and compressed against the flap by a mattress suture which penetrated the bolus, pedicle flap and palm and was tied over buttons. The base of the flap was detached and the margins set in three weeks later (Fig. 6C).

After a ten week interval the proximal phalanx of the middle finger was fused directly to the carpus (Fig. 6D). This recession resulted in some loss of flexor tendon amplitude but sufficient remained for function. It was possible to rotate the digit 170 degrees. Ex-tension was restored with a free tendon graft. Active opposition was gained by prolonging the flexor carpi radialis with a free graft to the transposed digit. Because of the tendency of the fourth and fifth metacarpals to deviate ulnarward, the brachioradialis was prolonged with a split tendon graft coursing from the dorso-radial side of the hand to the ulno-volar side of the proximal phalanges of the two fingers, thus increasing the stability of the pinch mechanism (Figs. 6E, F, G, H).

Case VI (FK). This patient had an incomplete paraplegia and severe injury to both upper extremities. The left thumb was destroyed and the metacarpals fractured (Fig. 7A). The original defect was resurfaced by a one stage abdominal tubed pedicle flap by Dr. Robert Payne (see Shaw and Payne, Surg. Gyn. and Obst., Vol. 83, pp. 205–209, 1946) (Fig. 7B). A claw contracture involving all the fingers with marked ulnar deviation and flexion of the wrist rendered the hand almost useless.

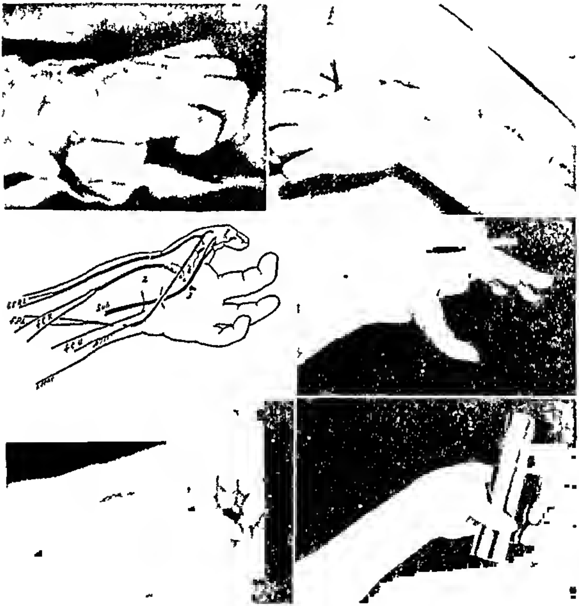
Steady traction flexing the metacarpo-phalangeal and extending the interphalangeal joints gradually restored finger function. The index finger was shortened, unstable and lacked extension, but flexion and sensation were present. The index finger was rotated into thumb position, the metacarpal shortened and fused to the carpus, maintaining po-sition by Kirschner wires. Soft skin and a relaxed web between index and middle fingers permitted closure of the cleft by a dorsal Z-plasty.

Active opposition was restored by prolonging the flexor pollicis longus with a free tendon graft (palmaris longus) around the flexor carpi ulnaris and thence subcutaneously to the transposed digit where it was inserted into bone at the base of the middle phalanx on the inner side. Extension of the digit was restored by prolonging a wrist extensor with a free tendon graft. The ulnar deviation of the hand was partially overcome by prolonging the flexor carpi radialis with a free graft to the dorso-radial aspect of the third metacarpal base.

To improve the flexor mechanics of the shortened and rotated index finger, the sublimis tendon was divided at the wrist and withdrawn from its fibrous sheath at the proximal inter phalangeal joint The sublimis commissure was cut and the tendon threaded beneath the carpal ligament and resutured (Fig 7C)

a b

c



e f

Fig 7 Case VI

a Original defect showing totalloss of thumb and flexion contracture of all interphalan

d opposition

This patient can now encompass and grasp objects The pinch between the rotated finger and the middle and ring fingers is firm He is forced to care for himself entirely with the left hand (Figs 7D, E F)

Case VII (JL) This patient presented a total loss of thumb plus loss of all tendons and nerves and part of the blood supply to the index and middle fingers Flexion contractures

of all fingers were marked and the wrist was flexed and deviated to the ulnar side, secondary to loss of the radial extensors and the abductor pollicis longus.

The dorsum of the hand was resurfaced with an abdominal pedicle flap and a three inch gap in the median nerve overcome by a direct suture of the common volar nerves to the proximal stump in the palm (Fig. 8A).

Following return of sensation to index and middle fingers the second metacarpal was shortened and rotated into thumb position, fixing it to the carpus with Kirschner wires. The wide dorsal cleft was resurfaced with the integument of the functionless middle finger which was filleted and amputated at the metacarpal base. Amputation of the terminal phalanx of the transposed digit was done because of the flexion contracture and excessive

Fig. 8. Case VII

a. Shows abdominal pedicle flap covering proximal portion of hand, rotation of second digit, and skin of amputated middle finger resurfacing the intervening defect.

b. Palmar view showing incisions for tendon transfer. Stabilization of wrist and further tendon transfer is contemplated

length. The flexor tendons of the ring finger which were intact but adherent to palmar scar were released and the sublimis tendon divided at its insertion, withdrawn at the wrist, passed beneath the flexor carpi ulnaris and carried to the transposed index finger to furnish opposition. Traction on the ring finger overcame the flexion contracture.

The above procedure was done recently on a totally useless hand. The object was to gain an opposable digit for the ring and little fingers whose profundus tendons are intact but function only moderately. It will be necessary to fuse the wrist in the functional position. Additional tendon work will provide finger extension, but this must be delayed until the tissues have softened (Fig. 8B).

SUMMARY AND CONCLUSIONS

1. A satisfactory reconstruction of the thumb should meet three criteria: (1) sufficient forceful flexion and extension to permit grasping, (2) opposability of the

t p of the reconstructed thumb to the pulp of at least one digit, (3) tactile sensation at its tip

2 A method for the reconstruction of subtotal or total loss of the thumb by transposition of an adjacent digit, meeting the above requirements, is described and seven cases reported

3 In most cases the transposition of an adjacent digit to thumb position requires the use of a pedicle flap to close the intervening defect

4 It is preferable to perform the transposition and the bony fusion in separate stages in order to obtain a more accurate positioning of the reconstructed thumb

5 Following fusion, further revision in the nature of tendon transfers and grafts or shortening of the tip is frequently necessary to produce a stable and properly functioning thumb

6 A damaged digit can often be more effectively employed in reconstructing a thumb than in attempting to restore its useful function as a finger

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RECONSTRUCTION OF THE FINGERS

GUILLERMO NIETO CANO, M.D.

Bogota, Columbia

R. M., age 21. Occupation: Factory worker. First seen on December 26, 1946. The patient comes for consultation with five fingers of the right hand smashed by a rubber milling machine on October 24, 1946. The only treatment the patient has received so far is some dressings.

Examination reveals that the second and third phalanges of the second third and fourth fingers and the distal extremity of the first phalanx of the index finger are missing. The skin is healthy around the proximal extremity of the first phalanges of the fourth and third fingers; there is practically no skin at all around the second (Figs. 1 and 2). The wound still shows some fragments of black rubber. There is widespread infection. Extension and flexion movements in the three middle fingers are somewhat limited.

December 3, 1946. First Operation. General anesthesia induced by inhalation.

1) Surgical cleaning of the wound in order to leave the first and fifth fingers without skin over part of the last phalanges and the second, third and fourth fingers with only the proximal extremities of the first row of phalanges. It was necessary for us to amputate from each of the three bones a small fragment in order to eliminate the chipped and necrosed parts and to promote a good healing of the grafts. After eliminating dead tissues and extracting other fragments of rubber from the wounded parts there is but little skin left to cover the bone fragments of the first row of phalanges in these three fingers (Figs. 3 and 4).

2) We took a piece of bone off the crest of the ilium in order to build up the skeleton of the three new phalanges. The piece of bone so obtained has both compact and cancellous tissue. Each new phalanx measures about 2 cm. in length by 5 mm. in width and 4 mm. in thickness. They are cut and drilled to match and are bound with wire sutures to the distal extremities of the phalanges (Figs. 3 and 4).

3) Over the manubrium of the sternum, toward the left, we made a Gillies tubed pedicled flap in order to cover the first phalanx of the middle finger and the artificial extremity of the same. We also made two other pockets under the skin which will serve for the same purposes for the second and fourth fingers.

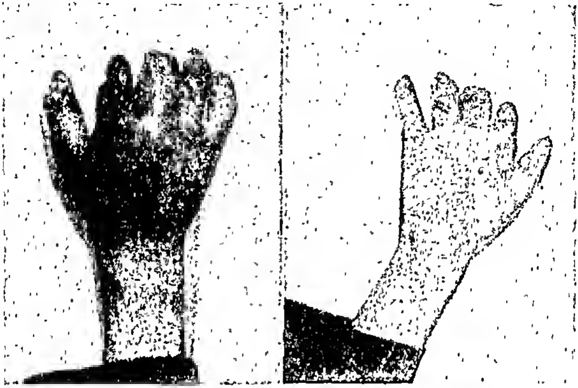
4) Skin grafting over the exposed areas of the first and fifth fingers.

5) The parts were placed in their proper position. Then they were sutured and secured (Fig. 5).

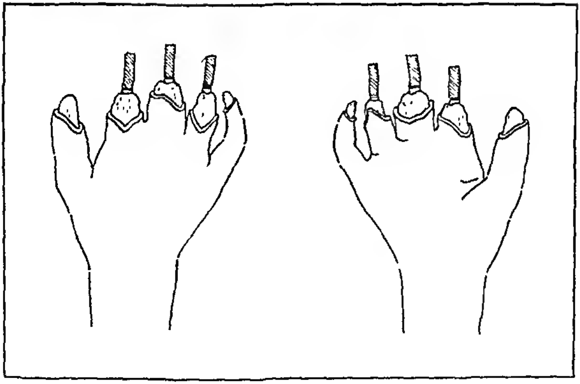
December 7, 9 and 11, 1946. Dressing; grafts look good. The sutures were removed on December 12.

December 20, 1946. Second Operation. Thiersch graft under the tube. Normal development.

January 14, 1947. Third Operation. Partial covering with skin of the second and fourth fingers (Fig. 6, A and B).



Figs. 1 and 2



Figs. 3 and 4

February 12, 1947. Fourth Operation. The skin covering of the second and fourth fingers is completed (Fig. 6, C and D) and the end of the tube was cut off

from the chest. The bone graft designed to lengthen the index finger has shortened itself to a fifth of its original size. (This fragment was extracted and sent to the lab. Lab reported "bone tissue with zones densely infiltrated with polymorphonuclear leukocytes. Oedema and small zones of necrosis were also present.")

March 11, 1947. Fifth Operation. Severance of the second and fifth fingers' adherence to the chest. The hand is now free. The skinless *zones* in the chest are covered with stamp sized skin grafts.

April 7, 1947. Sixth Operation. Skin graft (dermatomic) to improve the appearance of scars on the chest. This operation was performed by Dr. Herbert Conway of New York Hospital, while on a visit to this country.

May 3, 1947. The patient left the hospital.

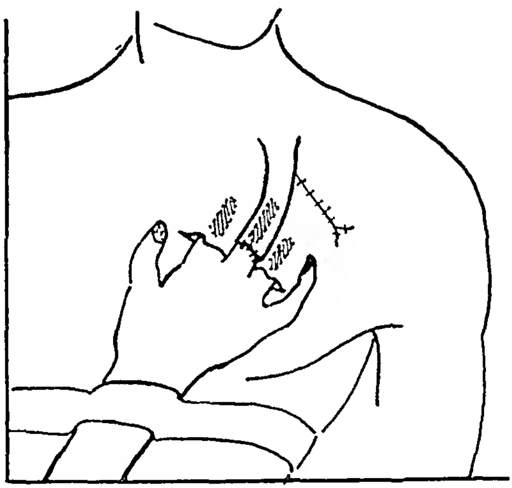


FIG. 5

June 9, 1947. Control. The patient was able to go back to his former occupation; he was assigned to the same place and with the same salary he had before the accident. He wrote as well as before and the patient used his hand very well indeed in his daily work. We then took the photographs that appear in figs. 7 8, 9 and 10.

SUMMARY

After a severe smash of the fingers of the right hand a conservative treatment was attempted with the remaining fragments of the first row of phalanges in the second, third and fourth fingers, and the lengthening of them, using as skeleton part of the iliac bone, and the skin of the chest. Except for the loss of the bone graft applied to the index finger the results were as intended, producing a very satisfactory functional result.

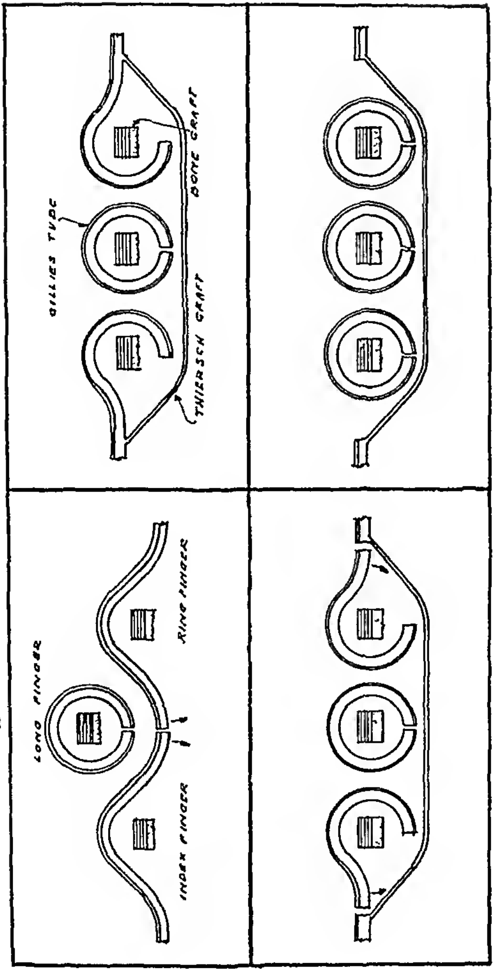
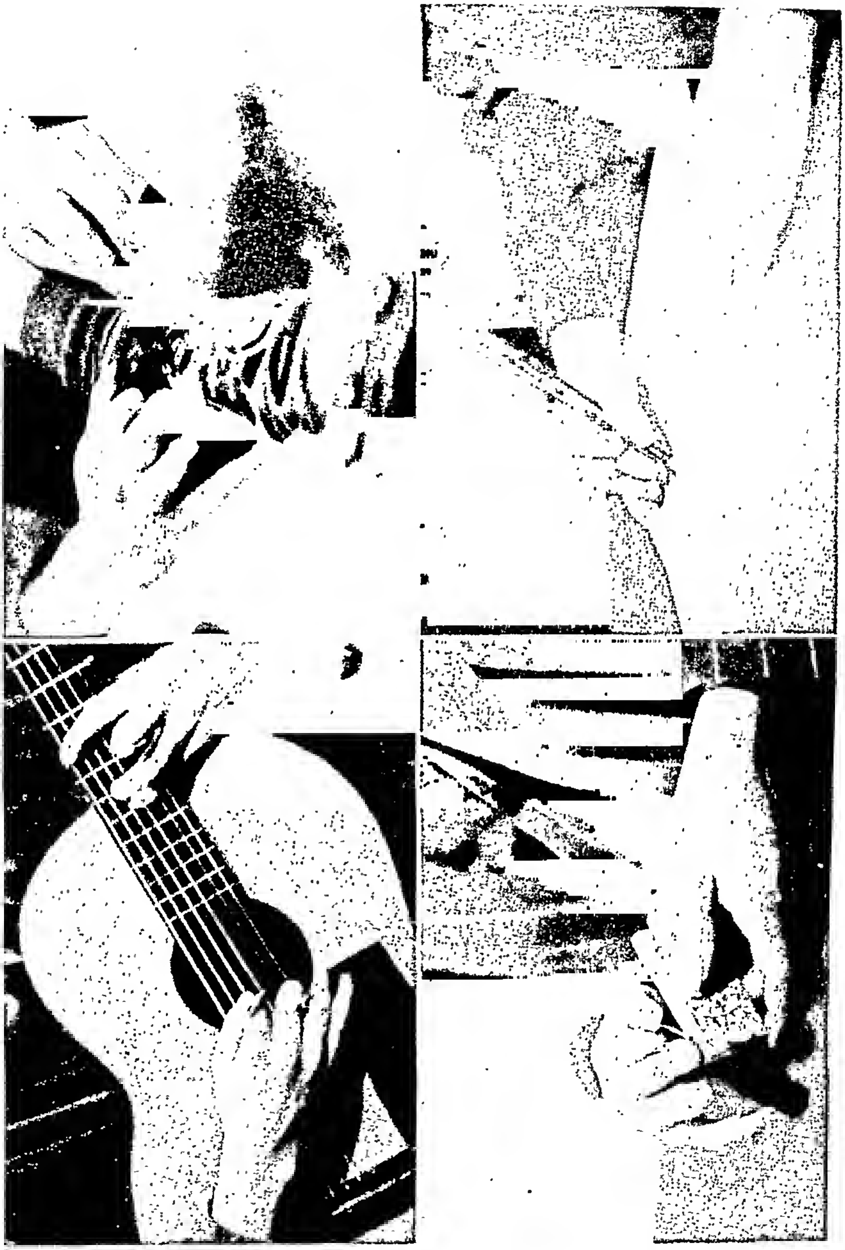

A
LONG FINGER
INDEX FINGER
RING FINGER
B
GILLIES TUBE
THIERSCH GRAFT
BONE GRAFT
C
D

Fig 6 A-D



Figs. 7-10

PLEXIGLAS SPLINTS: THEIR USE IN PEDICLE FLAP ATTACHMENTS*

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Plexiglas splints have been constructed and used to distinct advantage in the immobilization of the lower extremities during the attachment of pedicle flaps. Such splints are composed of simple monocurved sheets of plexiglas which are so fitted and laced as to encase both lower extremities; the relative position of the two extremities necessary for the attachment of the flap is maintained by several angulated connecting plexiglas strips (fig. 1). These splints are sturdy, clean, durable, and easily adjusted. They are light, cool, and comfortable for the patient. The occurrence of pressure sores is non-existent. The splint is simply and quickly applied in the operating room and subsequent examinations and dressings of the flap and donor site are readily accomplished (fig. 2).

Plaster of paris encasements as customarily used for joint fixation in flap attachment may, in comparison, be quite cumbersome and uncomfortable. Their application is time-consuming in the busy operating room and postoperative inspections and dressings may require cast-cutting. At best, skin does poorly encased in plaster.

Each plexiglas splint is made up of five standard components; thigh and leg casts, knee bars, thigh brace, and leg struts. The thigh cast is composed of two simple quadrangular plexiglas sheets which embrace the upper portion of the extremity. Each half contains regularly spaced perforations along its sides for lacings by means of which the two components are held in apposition to one another and by which adjustment for thigh circumference and padding are made. Additional holes are present to permit the insertion of bolts for the attachment of knee bars and thigh braces (fig. 3).

The leg cast is a composite of three rectangular sheets of plexiglas shaped to fit the general contour of the leg (fig. 4). Each piece possesses a number of holes for lacings and for the attachment of other components of the splint. The multiplicity of parts, while providing ample immobilization, permits one portion of the cast to be removed when a flap is raised from an underlying area (fig. 5).

A foot piece has been designed for attachment to the leg cast but it has proven quite unnecessary in the majority of cases (fig. 6).

The knee bars consist of two strips of plexiglas $2\frac{1}{2}$ inches wide which pass on the medial and lateral aspects of the knee and connect the thigh and leg casts. Multiple perforations permit the adjustment and maintenance of the knee in the desired angle of flexion (fig. 7).

... and are not to be construed as

Several connecting pieces are necessary and vary in minor detail with each case (fig. 8). A semicircular strip of plexiglas is used to maintain the relative position of the thighs. One or two angular struts serve to hold the legs in position. Leg struts bear the weight of the flexed and raised leg and thigh and are, therefore, designed to rest upon the bed (fig. 9). They are best constructed of plexiglas strips $\frac{5}{16}$ inch in thickness.

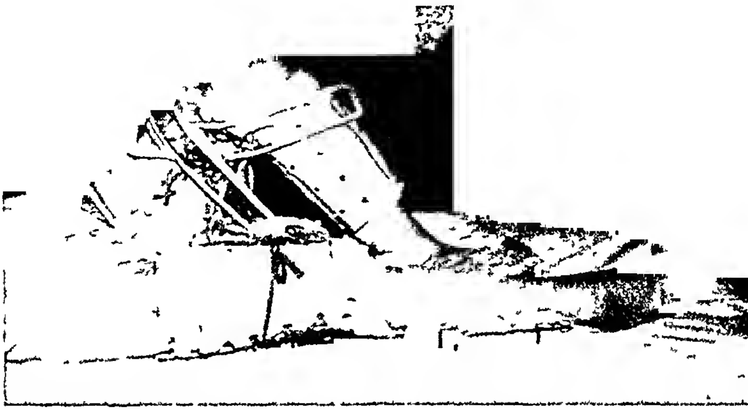

Fig. 1. Patient immobilized in plexiglas splint for attachment of a right leg flap to the anterior portion of the left foot.

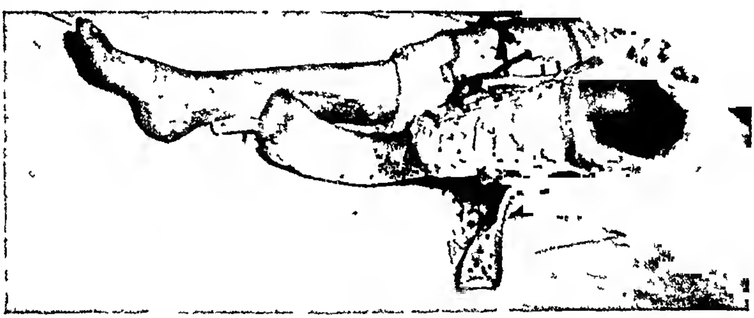

Fig. 2. Flap to anterior portion of foot. A skin graft covers the site from which the flap was raised The accessibility of the attached flap permits and encourages frequent examinations and simplifies subsequent care and dressings of the wound.

Plexiglas, in chemical structure a polymerized methyl methacrylate, is clear, transparent, thermoplastic, inert to body fluids and secretions, and possesses a surface hardness comparable to that of copper. It is available in cast sheets of a number of thicknesses and dimensions. Sheeting $\frac{1}{4}$ and $\frac{5}{16}$ inch thick have proven most satisfactory in the construction of splints; they are sufficiently strong and at the same time light in weight.

The fabrication of plexiglas is comparable to wood, brass or copper. One experienced in machining these substances will have no difficulty in working with this material. Plexiglas is received masked with tough paper; the patterns for

FIG 3 Thigh cast with lacings and bolts for attachment of other constituents of the splint.

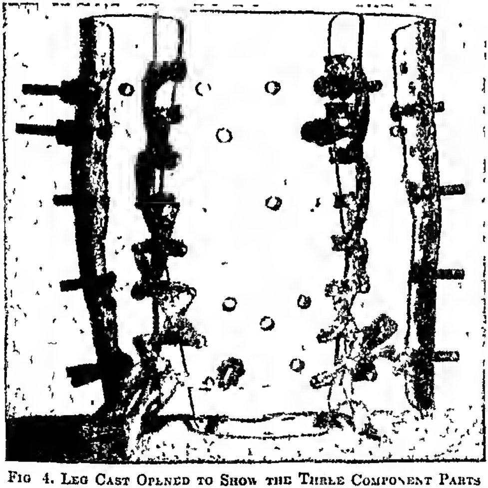

FIG 4. LEG CAST OPENED TO SHOW THE THREE COMPONENT PARTS

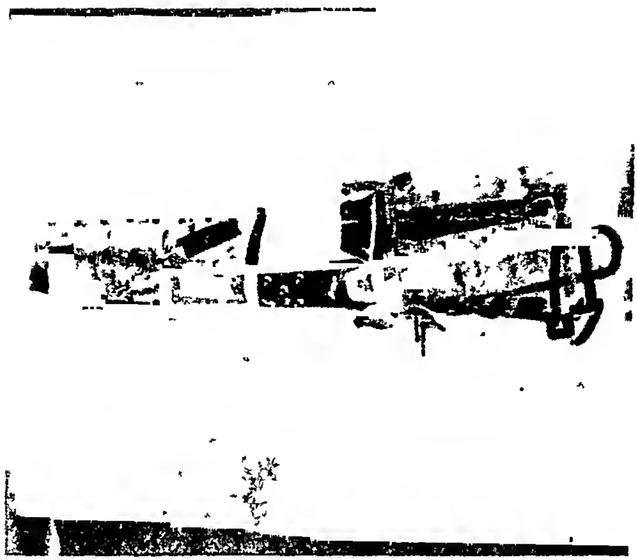

FIG 5. Leg cast consisting of only one component permitting flap to be raised from leg; knee bar connects thigh and leg casts.

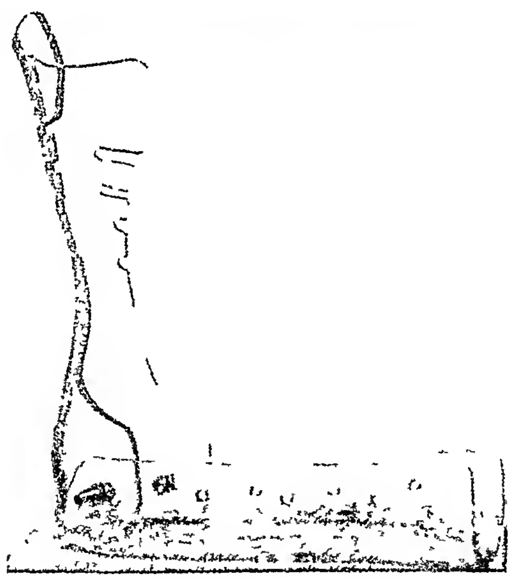

FIG 6 FOOT PIECE

the various components of the splint may be penciled directly on this paper. Jig saws, band saws, and circular saws designed for cutting metal are quite suitable for cutting plexiglas. Portable hand drills, standard verticle spindle drill

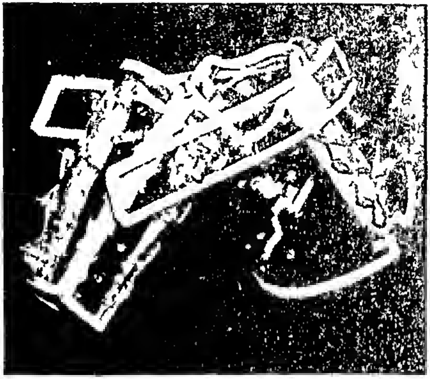

FIG 7 Knee bars joining thigh and leg casts and maintaining knee in desired angle of flexion

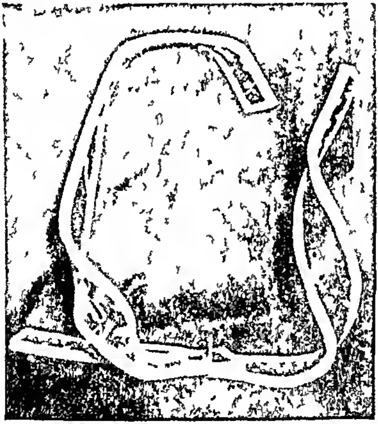

FIG 8 CONNECTING PIECES

presses or regular machine twist drills are satisfactory for drilling the holes for the lacings and connecting pieces Since plexiglas is both thermoplastic and a

poor conductor of heat, it is essential that care be taken to dissipate the heat during tooling of the substance. Water is the best coolant. Usually, however, cast sections can be tooled without lubrication.

Once cut and drilled, the forming of the thigh, leg, and foot casts is essentially a bending operation. Plexiglas becomes soft and pliable when heated to temperatures above 220° F, and may then be easily bent and formed into the desired shape. The cast sheeting cut to pattern is placed in an electrically heated air oven at a temperature somewhere in the range of 248–284° F (120–140° C). When the sheet is properly heated, little or no pressure is required to make the

FIG. 9. Plexiglas splint with leg strut resting upon the bed; this strut bears the weight of the raised and flexed left lower extremity.

plexiglas conform to a previously prepared form block of the lower extremity. When formed, cooling may be accelerated by means of a fan. The form block of the lower extremity required in the preparation for the components of the splint is made by applying a light plaster cast to an average lower extremity. When semihard, the cast is cut along its entire lateral aspect and removed. Several additional rools of plaster are then applied to the cast and allowed to harden. The surface of the form block must be smooth and void of imperfections.

The thigh brace and knee struts are heated and bent to meet the special needs

of each case. These pieces can always be returned to the oven and reformed in the event of improper shaping or for use in a later case.

On a day prior to operation the plexiglas splint is fitted and the knee struts and thigh brace prepared for the specific patient. The individual's lower extremities are first wrapped from hip to toes in several thicknesses of sheet wadding; this covering provides padding and, of more importance, protects the patient from burns by the heated plexiglas. The standard thigh and leg casts are laced. The extremities are placed in the position essential to the attachment of the flap. Knee bars are so bolted as to maintain the desired flexion of the knee joint. The thigh brace and leg struts are then removed from the oven and so shaped as to hold the thighs and legs in the correct relative positions. The most satisfactory results are obtained when the struts are so constructed as to rest upon the bed rather than cross the legs anteriorly. The full weight of the flexed leg and thigh is thus shifted from the patient to the bed (fig. 9). After these pieces have cooled, the splint is ready for reapplication in the operating room.

Plexiglas, by virtue of its physical and chemical properties, provides a material which has and will continue to find an increasing number of applications in surgery. The plexiglas splint provides a comfortable, readily applied, and very adequate method of immobilizing the lower extremities for the attachment of cross leg flaps.

REDUCTION OF MASSIVE BREAST HYPERTROPHY

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In order to present the experience gained in twenty-five years of doing mammaplasties, we recently produced a film in sound and color using the above title, in which it was intended that the colorcinematography would be so exact as to leave no doubt about any phase of the surgical technique, with the accompanying narration timed to the technique, explaining each step as encountered. This film has now been shown before various assemblies* and while receiving generous applause, each showing left the producer with the distinct impression that it fell rather short of the intended ideal. This was further emphasized by the many questions asked in the discussion.

It is obviously impossible to give a complete course on mammaplasty in the fifteen minutes allotted for the showing of the film, nor was it planned to be so complete; but the discussion fully brought out that there was much more that could or should have been said in the narration, so that now, both for the sake of documenting this film presentation, as well as to answer more completely some of the questions asked, the printed word will be used to allow a leisurely study of the problem.

Massive breast hypertrophy is a condition very frequently encountered. It is the subject of justified complaint and is entitled to relief. While there is considerable argument about its etiology, there is no question whatever about its proper treatment; that treatment is radical surgery. Being an external body deformity, its treatment very properly falls in the domain of plastic surgery.

There are at present two well defined procedures in vogue, both of them meritorious to a certain extent, and both of them subject to risks peculiar to their method. One method seeks to avoid tissue necrosis by simple amputation, leaving just enough tissue to suggest a reasonably normal sized breast, and then transplanting upon this mass the separately amputated areola and nipple as a free graft. The other method, which is demonstrated in this film, maintains the nipple and areola in undisturbed continuity with the glandular portion, and at the same time creates a well shaped normal appearing breast.

Many questions have been asked about the physiology in a reconstructed breast. If lactogenesis is the function under consideration, the severance of the continuity of nipple and gland definitely destroys this function. If their continuity is maintained it leaves at least an anatomical foundation for such function. Usually such a function either does not exist at all in a very large breast, or only to a minimal degree; therefore it is not destroyed by surgery nor can it be created or recreated by it. However, the establishment of such function is practically

* Hollywood Hospital Staff, Los Angeles, Sept. 23, 1947; International College of Surgeons, Chicago, Oct. 1–4, 1947; American Society of Plastic and Reconstructive Surgery, San Francisco, Oct. 21, 1947; Marion Davies Clinic Staff, Los Angeles, Nov. 13, 1947; Fourth Congress, Latin-American Society of Plastic Surgery, Montevideo, Dec. 3, 1947; and Surgical Staff, Ramos Mejilla Hospital, Univ. of La Plata, Buenos Aires, Dec. 10, 1947.

never requested as an object of reconstruction; the sole reason for reconstruction is to obtain relief from physical and psychological distress, directly due to abnormal size, shape and position.

If erectibility of the nipple and erotic sensation are being considered, obviously the free transplanted nipple cannot compare with a nipple in which continuity of blood and nerve supply is practically undisturbed, although proponents of the other method appear to have demonstrated that this function returns to some degree even in the free transplanted nipple.

If destruction or preservation of an internal secretion is under consideration one may well reason that the removal of such an extensive source of that secretion by either method should have a tremendously disturbing effect on endocrine balance; but such effect does not take place. No discussion is offered here regarding endocrine influence in the physiologically normal breast; but in a breast which is composed almost solely of hypertrophied fibrous tissue and fat, the actual potentially active gland being practically infantile, there can be no more question of the existence of internal secretion than there is in fibrous tissue and fat in any other part of the body.

The above conception of the structure of a grossly enlarged breast is the reason for our paying so little attention to the preservation of the circulation which anatomically exists in the normal breast. The growth itself being so abnormal, we assume its blood supply to be equally so. Hence our objective is not to search for normally placed vessels, in order to prevent their destruction, but to clamp and ligate any bleeder encountered, being sure to leave the central core of the remaining breast tissue attached to the chest wall on the broadest possible pedicle of undisturbed circulation. By undisturbed we not only mean the non-severance of vessels, but also the avoidance of traumatizing in handling the remainder of the blood supply, for excessive or rough handling or twisting of the tissue may lead to thrombosis, which can as readily result in necrosis as if the vessels had actually been severed. We may occasionally cut one or more of the larger vessels, but we depend on the continuity of many smaller ones for adequate circulation. In actual practice it is surprising how little ligating has to be done; most of the minor bleeding is well controlled simply by clamping for a few minutes.

The main reason for presenting this work is that beyond mere reduction in size and incident relief from physical distress, the technique of the operation attempts to correct psychological distress by creating a form, shape and position which approaches the virginal ideal; a fullness and firmness of bosom which exacts for its owner the appreciation universally accorded a well shaped female figure. Such a result cannot be produced unless there is the most painstaking preoperative planning. It is well to do this several days in advance, taking photographs for the record, as well as for rechecking the delineation pattern. The application of the skin markings is done with the patient standing; it is then checked with the patient lying flat, as on the operating table. This is done to note the apparent change in pattern configuration, as the direct result of the change in position. It also frequently suggests a modification of the original design, for the final result must be acceptable in both positions.

Sculptural visualization is first in importance in the proposed operative plan. Surface anatomy and geometrics serve to indicate the delineations, but not to locate them. There are two patterns which must be applied if a satisfactory correction is to be obtained:

First: The pattern of skin incisions, which affect the shape that is to be created only from the skin fixation viewpoint.

Second: The deep pattern for elimination of the excess breast tissue, the realignment of the remainder, and its fixation on the chest wall.

To design the skin pattern any suitable marking fluid may be used; our preference is 5% Brilliant Green in 95% Alcohol. For a marker we use the ordinary wood applicator with a very small amount of cotton on one end. But just as the artist makes a crayon sketch in a tentative design before he applies his colors, we use ordinary green ink to draft a tentative outline, marking and erasing as

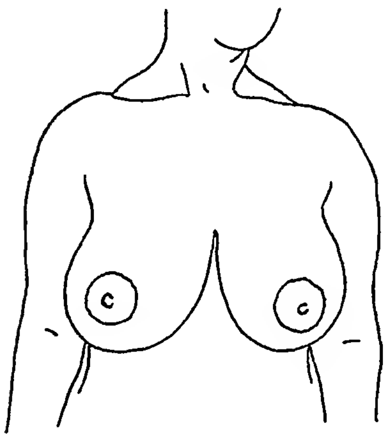


Fig. 1

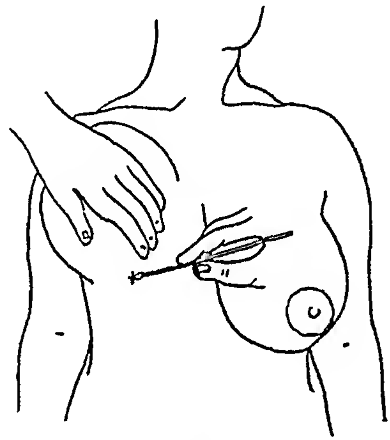


Fig. 2

Fig. 1. Hypertrophy and Prolapsus of Breasts
Fig. 2. Right Breast. Design Started by Marking Base Point on Sub-mammary Line

seems desirable. An instantaneous eraser is an applicator dipped in Hypo, Purex or similar oxidizing agent. The permanent stain is not applied until the tentative pattern has been found acceptable in all positions. The design for the deeper transformation should take form in the surgeon's mind, as he studies each case, but it must be as fixed in his mind as the permanent stain is on the patient's skin.

DESIGN

1) The first fixed point from which to proceed is the level of the anatomical lower border of the breast. In a very heavy and very pendulous breast this may be displaced downward to quite an extent, but upon full elevation of the breast and palpation, the dividing line is readily established and marked (Figs. 1 and 2); the same level is established under the other breast, and the two joined by a line across the midline of the body (Fig. 3).

2) To obtain the new border line of the breast, we elevate the breast and draw

a curved line through the base point mentioned above, running it mesially and laterally upward along its abduction curve to the level of the nipple line (Fig. 4). Upon the anterior wall of the pendulous breast we then draw its exact parallel

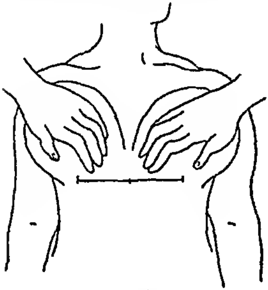


FIG. 3

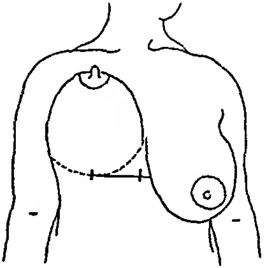


FIG. 4

FIG. 3. Right and left base points joined in horizontal line to form median base line.
FIG. 4. Curved line following sub-mammary fold touching base line and forming posterior "lip" of new lower border.

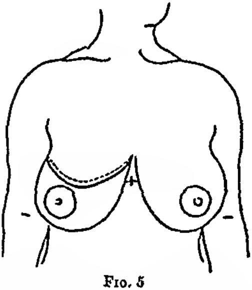


FIG. 5

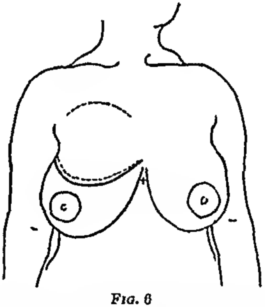


FIG. 6

FIG. 5. Dotted line indicating posterior "lip" of new lower border. Heavy line indicates the anterior "lip".
FIG. 6. UPPER DOTTED LINE INDICATES PROPOSED NEW UPPER BORDER OF BREAST

(Fig. 5). During the final stages of the operation these two lines are brought together, establishing the new lower border of the breast.

3) With this level visibly marked, we can now visualize and establish the upper border of the new breast which we intend to create. Anatomically speaking, we might designate the fifth interspace for the lower and the second interspace for

the upper border, and anatomically this would be correct, but sculpturally it would be far from satisfactory, and a sculpturally acceptable result is what we are striving to create (Fig. 6).

4) With the upper and lower borders established, we proceed now to mark the new locus of the nipple and areola (Fig. 7). For quick and easy marking of the new areolar site, we use a specially constructed ring of about 4cm. in diameter. Drawing our marking applicator around the inside of this ring marks the areola for a breast of a normal sized torso; drawing it around the outside of the ring marks the larger areola needed for the breast suited to a larger torso (Fig. 8). Note how this perfectly round mark in the standing position becomes an oblique ovoid in the recumbent position. Were we to place it exactly midway between these two borders, we might again be anatomically correct, if our subject pos-

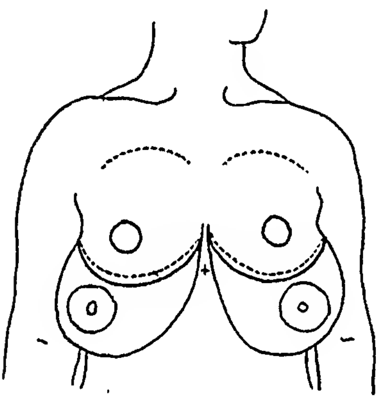


Fig. 7

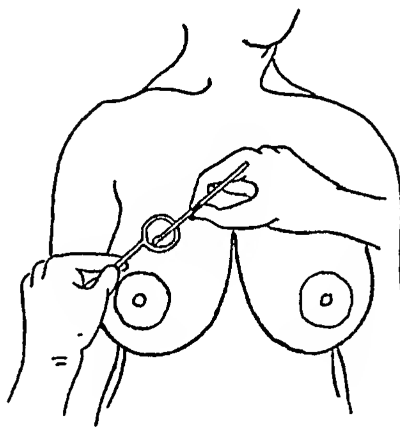


Fig. 8

Fig. 7. New Locus of Areola Designed on Each Side

Fig. 8. Showing the method of marking the circumference of the new locus by using a special metal ring. The same procedure is followed to reduce the size of the original large areola.

sessed virginal size and firmness of the breast; but a fully mature breast has normally a greater fullness in the lower hemisphere than in the upper, and in harmony with this, the nipple is similarly slightly lower. Apply the marking fluid to the new position with the patient standing, then have her recline and check particularly that it is not too close in relation to the clavicle.

Having satisfactorily marked the level of both nipples, their distance and equidistance from the median line of the body should be checked. If there is a decided difference in size between the two breasts it will be noticed, especially in the recumbent position, that the nipple on the larger and lower breast is farther from the median line than in the other breast. This deviation from the normal anatomical position must be noted and balanced with the other side. Sculptural visualization determines the new position of the nipple in relation to the midline. Only this sculptural visualization can establish its ideal location. In a large

breast the areola generally participates in the expansion and hence it needs reduction in size also commensurate with the reduction in size of the breast. By using the special ring mentioned before, the areola is thus reduced to a size corresponding to the design made in its new locus.

The foregoing has outlined the typical buttonhole operation first performed by Villandres-Dartiquo or Dufourmentel.† It fully corrects the pendulousness, but gives as a result a flat or spread-out breast. To obtain a more virginal conical contour, the horizontal spread of redundant skin should be eliminated. Experience has shown that a right angle inverted V with the apex in the center of the new nipple locus and descending to the new lower border circumference usually serves well in achieving the desired conical shape. With the marking of these inverted V's the skin design is completed (Fig. 9).

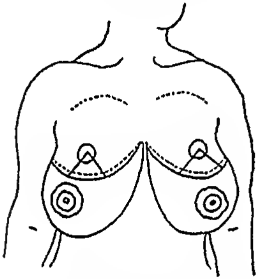


FIG. 9

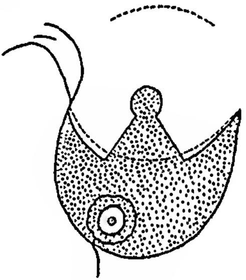


FIG. 10

FIG. 9. Right angle inverted V with apex in center of new locus of areola. Notice also corresponding reduction in size of original areola.

FIG. 10. Completed design after erasure of unnecessary lines. Shaded portion indicates area where skin will be ablated.

The operation is begun with the skin incisions following the skin design, and the ablation of the portions marked out as redundant (Fig. 10). This includes the circular area denoting the new areolar locus; the triangular area from the new nipple locus to the lower border line, and the elliptic patch between the anterior and posterior lower border lines. Experience has shown that if the superficial circulation is left fairly undisturbed, especially in the vicinity of the areola, the much dreaded danger of necrosis of the nipple is greatly reduced; hence the ablation is made as close to the skin as possible. In the area immediate to the areola this ablation should be practically intradermic. The remainder of the breast is separated by blunt dissection with a gauze sponge. This is done at the line of cleavage between the superficial fascia and the fascia enveloping the breast. The area which will serve to form the new bed is similarly prepared by blunt

† MAX THOREK: Plastic Surgery of Breast and Abdominal Wall. pp. 183-186. April, 1948.

undermining to a level well above the second rib. We have now before us the denuded gland for alteration in size, shape and position. Here is where the aforementioned mental pattern comes into play.

From the esthetic point of view the most undesired extension of the mass is the bulge toward the axilla; hence a radial sector of adequate size is resected laterally and inferiorly. The apex of this sector should not approach the nipple area closer than 2 inches in order to preserve intact the central core of the gland; laterally it should extend to the full extension of the gland toward the axilla, and frequently even beyond this limit in order to remove the lateral extension of fat seen in many of these cases; posteriorly it must extend to the fascia covering the chest musculature. If this resection does not bring about a sufficient reduction in mass, then a small radial section may be similarly removed from the medial

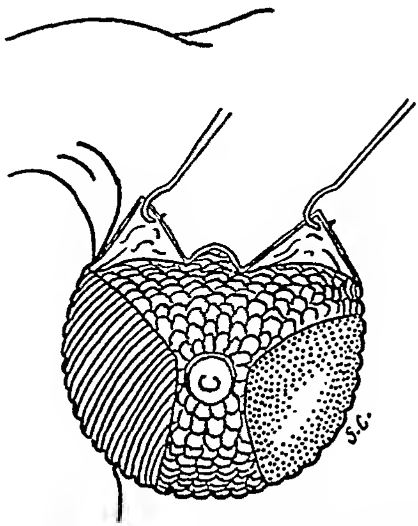


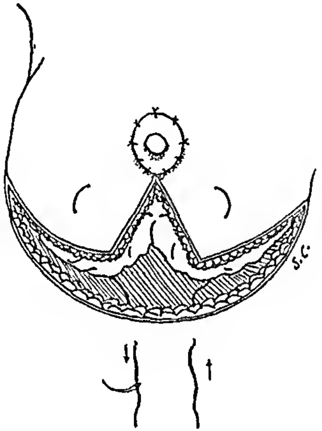
FIG. 11. Excision of lateral bulge in triangular wedge-shaped form with apex near the areola. Medial triangle indicates area of additional excision of hypertrophy when necessary.

inferior sector (Fig. 11). This leaves a central core of breast mass absolutely undisturbed in its circulation with the vessels of the chest wall, a factor well to be considered if necrosis of any part is to be avoided. However there is as yet no procedure devised which is proof against ischemic necrosis resulting from thrombosis.

No resection is made from the superior sector of the gland since this sector of the pendulous breast is too flat already. Hence in order to give the new breast the fullness and bust effect, all the available tissue of this area has to be conserved, shifted to a higher level on the chest wall, and even augmented by pushing upward some of the lateral portions of the mass. Anatomically, conservatism in this area maintains intact the circulation derived from the mammary and long thoracic arteries. To effect this shift of the breast to a higher level on the chest

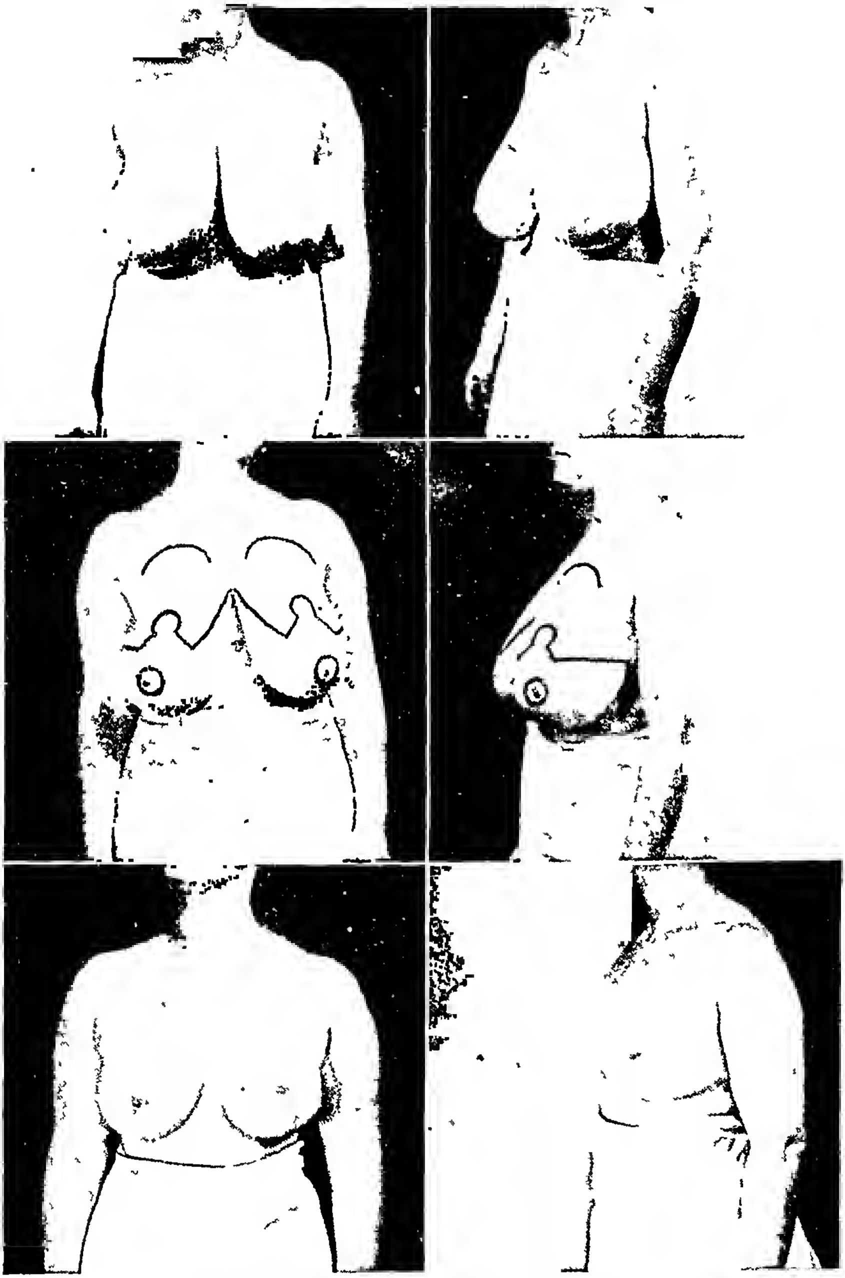
wall, the aforementioned blunt undermining between superficial and deep fascia has to be extended well above the existing upper border of the breast.

In order to maintain the breast at this higher level, and to prevent the lifted portion from slipping medially or laterally, one or two sutures serve to attach this portion to the fascia over the second rib. This suture is functional only during the early days of healing; the permanent fixation depends on the extensive formation of fibrous tissue between the skin and the raw surface of the breast mass. This same shaping force is also the factor which molds the remainder of the breast into a conical contour without the need of suturing the cut edges of the resected area.



Were we now to bring together the covering skin flaps and suture them with appropriate fascial and skin sutures, we might obtain a rather nicely shaped breast, and certainly one greatly improved by comparison with the original condition. However, in an adequately prepared large bed for the new breast, experience again has shown that spreading takes place in all directions, and the present conical shape will be rather flat in a few days, particularly so if a firm compressive dressing is applied. Hence in order to maintain the conical contour till healing has proceeded far enough for its preservation, we apply a splint-and-fixation device which absolutely maintains this shape during such a period. For this purpose we use a heavy non-absorbable suture which enters the fascia through the skin below the baseline point, continues into the center of the medial

A B



C D

E F

FIG. 13. A and B Front and profile views, before operation. C and D Front and profile views showing markings for incisions. E and F Front and profile views, after operation.

flap from the underside, emerges through the skin and reenters the flap about 1 inch from its entrance, transfixes the breast fascia about 1 inch below the areola and continues through the lateral flap as it did through the medial one it finally emerges through the skin about 1 inch from its original entrance As this suture is drawn tightly the breast is compressed into a narrow conical shape, holding it absolutely firm in its new bed (Fig 12) In addition to the above this combined splint and fixation suture serves also to remove the tension from the edges of the skin flaps, serving as well to baste the center of the flaps to the breast mass underneath This special suture is left in place for 12 days In order to prevent it from cutting into the skin, its visible three sections are underlaid with a small pad of gauze

Approximation of the fascial and skin borders becomes now an easy procedure for it is accomplished with very little tension We prefer interrupted rather than running sutures for the fascia, placed about 1 inch apart The areola is secured in its new locus with interrupted sutures through the skin only Usually we do this just before bringing the flaps down, for it helps to center the areola more readily in the molding process The skin edges are closed with interrupted or running lock sutures

Ordinary gauze pads are used for dressing, buffered with lap pads which are held in place by means of 3 inch adhesive bands applied in the shape of a bias siere

During recovery any position comfortable to the patient is permitted, so is full motion of the upper extremities The patient may be up and about as soon as the anesthetic has fully worn off Four days is the average hospitalization Skin sutures are removed in 8 days and tension sutures in 12 to 14 days

CONCLUSION

The complete technique of the one stage operation for reduction of massive breast hypertrophy is presented

In 25 years of experience with mammaplasties this method has been found to be the most effective and gratifying in the relief from this distressing condition

The result obtained is not only the relief from physical discomfort, but of the mental suffering as well, the former feeling of depression and inferiority is replaced by heightened morale, happiness and feminine pride

Acknowledgement and thanks for the preparation of the sketches are due my assistant, Dr Salvadore Castanares

MANDIBULAR BONE GRAFTS

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AND

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Standardization of technic and evaluation of the results of surgical repair in bony loss of the mandible were made possible during World War II by the concentration of facial injuries in plastic centers. Of the battle casualties admitted to our center, 92 had injuries to the mandible requiring bone grafts. Recent literature on this subject has dealt, for the most part, with grafts obtained from one source.[1, 2, 3, 4] Because of the large number of cases treated at this center and because several types of bone grafts were used, we feel that observations of the successes and failures encountered should offer a worthwhile perspective of the entire problem.

EARLY DEFINITIVE CARE

One of the major medical accomplishments of World War II was the formation and efficient functioning of maxillo-facial teams which operated in evacuation, field and general hospitals in the various oversea theaters. The concepts of minimal debridement, adequate early repair of facial wounds, adequate immobilization and maintenance of normal occlusal relationships paid tremendous dividends in the long-range care of these patients. The results of this early efficient care were obvious when the cases arrived at our center. An average period of two months had elapsed from the time of injury until the patients were admitted to our service. On the whole, occlusal relationships had been well maintained with multiple loop wiring or arch bars. In a certain number of cases, particularly those with edentulous proximal fragments and extensive bony loss, it was impossible to maintain normal occlusion with simple intermaxillary fixation; in these instances there were varying degrees of malposition.

Practically all of the cases had localized bone and soft tissue infection, with extra- or intra-oral drainage, or both. Our early definitive care consisted of:

(1) Institution and maintenance of adequate oral hygiene.

(2) Control of infection with penicillin and sulfadiazine.

(3) Sequestrectomies and incision and drainage of localized collections of pus as indicated. The generally accepted edict of conservatism with regard to sequestrectomies was closely observed. Only when a portion of the mandible presented itself in the wound or was obviously devitalized was it removed.

(4) The extraction of fractured teeth and roots and those with periapical involvement was accomplished as soon as feasible, although an attempt was made to temporarily retain as many teeth as possible in order to facilitate splinting.

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† Formerly Major, Medical Corps, Army of the United States.

(5) Adequate splinting and immobilization of jaws. As soon as possible after admission to the plastic service splints were constructed. In most cases, these

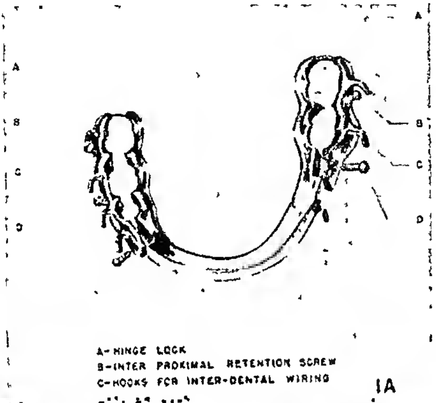


Fig. 1a Screw lock, wing-type cast metal occlusal splint used to maintain position of mandibular fragments prior to and during reconstruction of mandible by bone graft
Fig 1b Splint in position, showing exposed occlusal surfaces of teeth

were screw-lock, wing-type, cast silver appliances (Figs. 1a and 1b). They were made of cast german silver, with a 16-gauge round wire as the hinge uniting the buccal and lingual flanges of the splint Locking was accomplished by a stainless

steel screw which held the two flanges together. The splints were cemented in place for protection of the teeth, rather than as a retentive measure. A complete description of this apparatus is given in an article by W. D. McCarthy, D.D.S.,[5] the member of our service who devised the splint. During splint construction, if there was malposition of mandibular fragments, the stone model for the splint was sectioned and re-united in normal position. This made it possible to maintain relatively normal relationships of the bony fragments with the splint. There was minimal resultant injury to the enamel or peridental membrane. When intermaxillary fixation became necessary prior to bone graft, and ordinary arch bar was frequently used in the upper jaw, if there was a relatively full complement of teeth. Where a number of teeth were missing, a splint similar to the one used in the lower jaw was constructed.

In twelve cases of this series a short, edentulous, malposed proximal fragment was controlled by means of an adaptation of the Kazanjian pin. This pin was attached to the posterior portion of the splint with a stainless steel screw. In those cases with extensive bony loss on one side of the mandible, there was frequently a loss of inter-dental relationships, with a shift of the lower jaw toward the injured side. This was controlled by attaching training flanges to the splint on the lower jaw. These flanges were projections of metal attached to the buccal side of the splint and extending about 5 mm. above the occlusal surface of the mandibular teeth. It functioned as a guide in closure of the mouth and adequately maintained occlusal relationships.

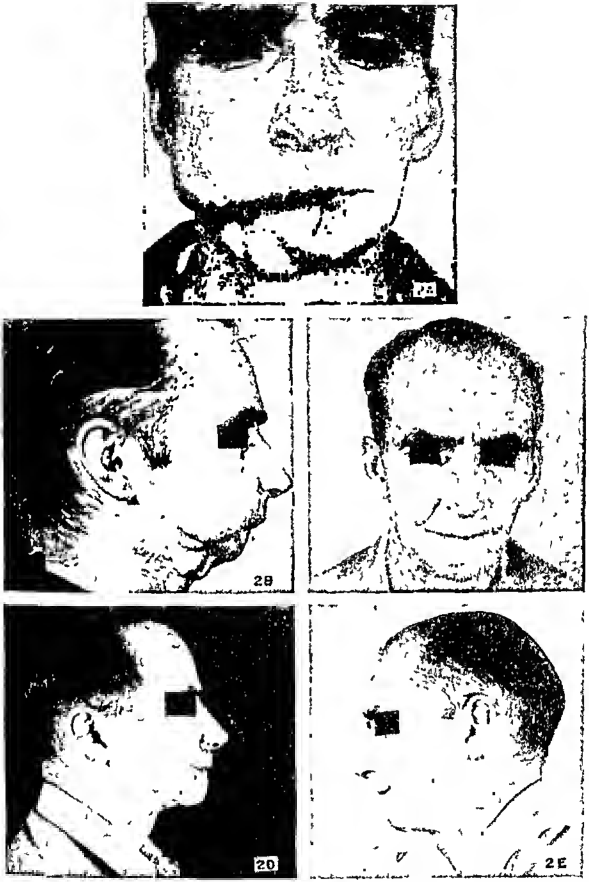
(6) Trismus therapy. When admitted to our hospital, most of the patients had varying amounts of trismus, resulting from prolonged intermaxillary fixation, tempero-mandibular joint damage, or extensive scarring within the oral cavity. Therapy which utilized the Stout trismus apparatus was instituted early and was continued until a relatively normal mouth opening was obtained.

(7) High caloric diet and vitamin therapy. Most of the patients had been on a liquid diet for several months prior to arrival at our hospital and had lost varying amounts of weight; they received a high caloric intake, supplemented with vitamin therapy.

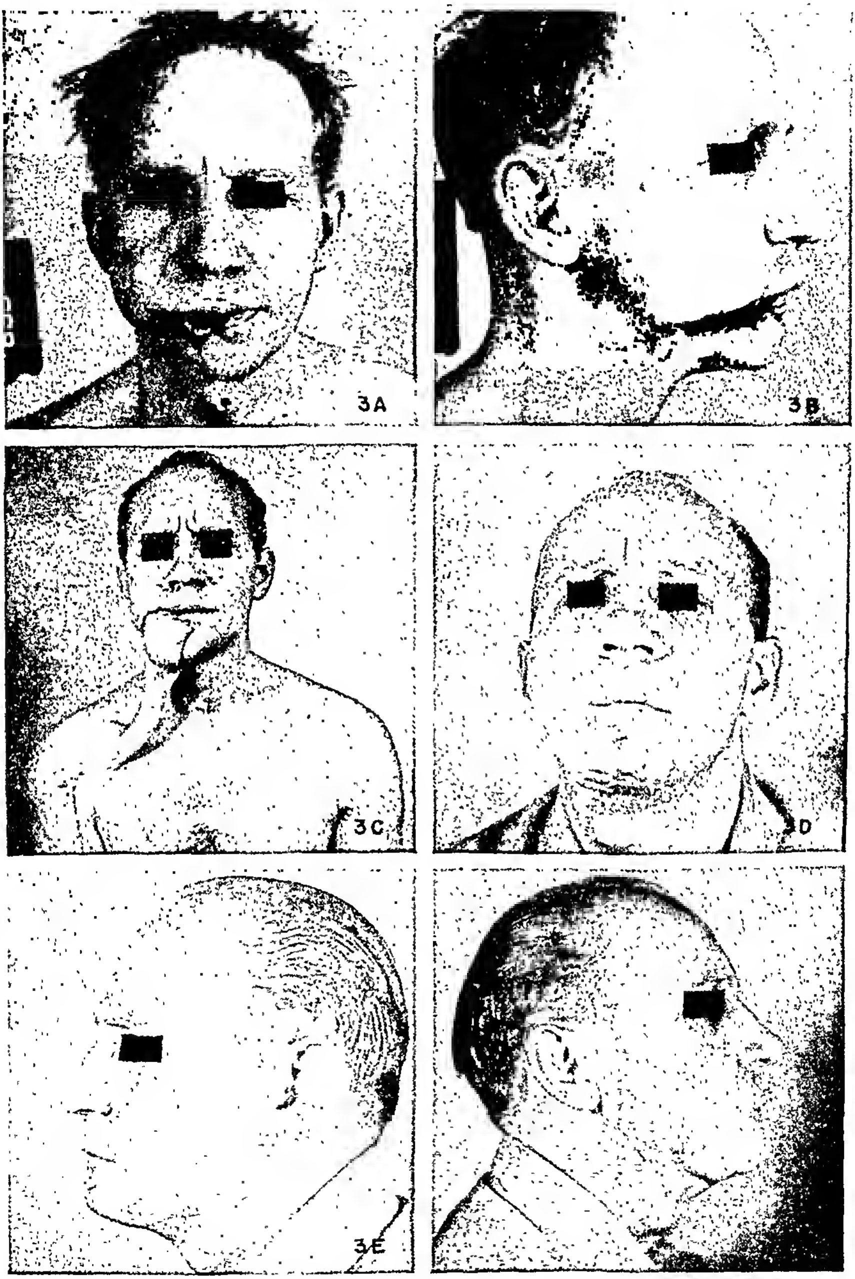
LATE DEFINITIVE TREATMENT

Loss of Soft Tissue. The presence of an adequate soft tissue covering is essential to the success of any bone grafting procedure. All of these cases had some cicatrix in the skin overlying the bony defect. Usually these scars could be excised at the time of the bone graft and closure of the soft tissues accomplished without tension. In a certain number of cases, however, loss of skin, subcutaneous tissue and mucosa over the bony defect was so extensive that restoration of continuity of the mandible with bone graft would have been impossible without first supplying the overlying soft structures. This was accomplished with local flap shifts where feasible (Figs. 2a, 2b, 2c, 2d, 2e) or with neck or neck-chest tubed pedicles (Figs. 3a, 3b, 3c).

Restoration of Continuity of the Mandible. An average period of nine and one-



ble by rib graft, and contour of chin by cartilage graft.



FIGS. 3a and 3b. Gunshot wound resulting in full thickness loss of lower lip and right cheek and destruction of entire body of right mandible.

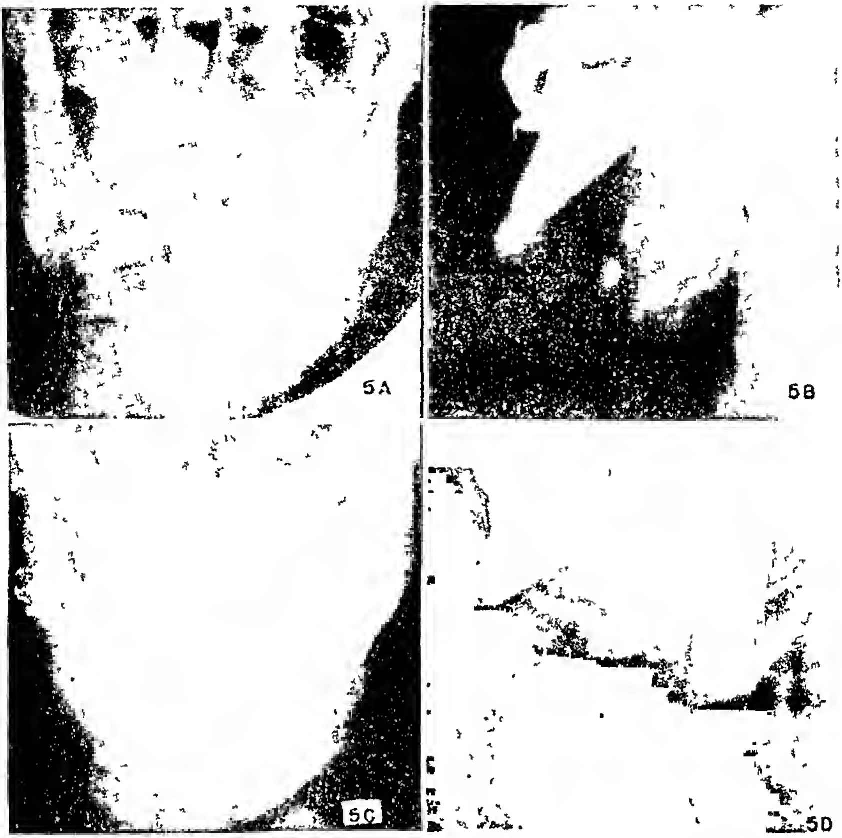
FIG. 3c. Covering and lining of lower lip and right cheek supplied by a flap lined with a split thickness skin graft and carried by a neck-chest tubed pedicle.

FIGS. 3d, 3e, 3f. Appearance of patient following iliac graft to restore mandibular continuity and dermal fascial fat graft to correct contoural deformity of right side of face.

half months elasped from the time a patient was admitted to the hospital until he was ready for bone graft. A minimum of three months, during which time the jaw was completely free from drainage, was insisted upon before the surgery was performed. If soft tissue had been supplied by either of the above mentioned procedures, we waited approximately two months before doing the bone graft in order to allow for stabilization of the local circulation.

Figs. 4a, 4b, 4c, 4d. X-rays of mandible of patient shown in figures 2a, 2b, 2c, 2d, 2e. Figs. 4a and 4b show massive defect of symphysis and right body of mandible. Figs. 4c and 4d show mandible after reconstruction with a rib graft.

Evaluation of Tibial, Rib and Iliac Grafts. The osteoperiosteal graft, obtained from the tibia, is used for minimal bony defects of one-half cm. or less. It is cut thinly, including a minimal amount of cortex with the periosteum so that it can be easily folded over the defect and tucked under the adjoining bone fragments. As shown in Charts I and II, this type of graft was used not only as a primary graft in 36 cases, but also as a "feeder" graft where there had been failure of



FIGS. 5a, 5b, 5c, 5d. X-rays of mandible of patient shown in Figs 3a, 3b, 3c, 3d, 3e, 3f. Figs. 5a and 5b show loss of entire body of right mandible. Figs 5c and 5d show mandible after reconstruction with an iliac graft. Note osteoperiosteal "feeder" graft in Fig. 5d.

CHART NO. I

Types of grafts used

TYPE OF GRAFT	NUMBER USED	INTERVAL BETWEEN INJURY AND GRAFT	AVERAGE TIME FOR CLINICAL UNION	FAILURE OF UNION
		months	*weeks*	
Osteoperiosteal..	36	8.7	10.3	1
Iliac crest	22	11.0	12.0	5
Rib..	25	9.3	11.5	4
Tibial block	9	10.0	12	1
Total.... .	92			11

union or resorption of a previously placed rib or iliac graft. (Figs. 6a, 6b.) When used as a primary graft, there was one failure, a result of infection. As a

CHART NO II

Analysis of failures

TYPE OF ORIGINAL GRAFT	REASON FOR FAILURE	TYPE OF SECONDARY GRAFT	TIME FOR CLINICAL UNION	COMMENTS
Rib	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for osteoperiosteal graft Iliac graft finally used successfully to produce union
Rib	Resorption and decalcification of distal end of graft	Tibial block and osteoperiosteal	12 weeks	None
Rib	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for osteoperiosteal graft Iliac graft finally used successfully to produce union
Rib	Resorption and decalcification of graft	Osteoperiosteal	—	Residual bony defect too extensive for oesteoperiosteal graft Iliac graft finally used successfully to produce union
Iliac	Inadequate immobilization of proximal fragment	Osteoperiosteal	12 weeks	None
Iliac	Infection	Iliac	—	Failure of union at distal end of second graft, probably due to inadequate CIRCULATION, since graft was placed under skin and subcutaneous tissue obtained from neck-chest tubed pedicle Osteoperiostial feeder graft finally produced good union
Iliac	Inadequate immobilization of proximal fragment	Osteoperiosteal	10 weeks	Original iliac graft extended from right to left ramus

CHART NO. II—*Concluded*

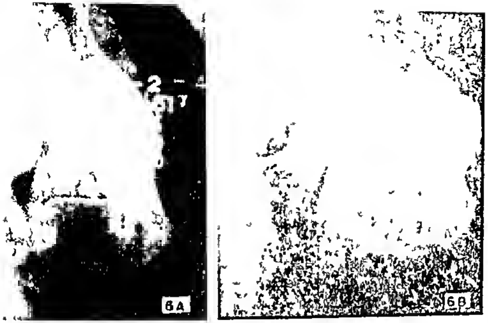
TYPE OF ORIGINAL GRAFT	REASON FOR FAILURE	TYPE OF SECONDARY GRAFT	TIME FOR CLINICAL UNION	COMMENTS
Iliac..........	Failure of union at distal end of graft, cause unknown	Osteoperiosteal	7 weeks	None
Iliac..........	Infection; probably due to Kirschner wire used to stabilize symphysis	Osteoperiosteal	12 weeks	Both the original graft and the osteoperiosteal "feeder" were bilateral to replace a major loss of the body.
Tibial block...	Unknown	Iliac	12 weeks	Bilateral graft.
Osteoperiosteal	Infection	None	—	Patient transferred to another plastic center before secondary graft could be done.

"feeder" the osteoperiosteal graft did not produce union in three cases. (See Chart II.)

The combination of a block of cortical bone from the tibia, overlaid with an osteoperiosteal graft (Figs. 7a, 7b, 7c, 7d) is useful in defects of moderate size. It is easily obtained, the sturdy section of cortex serves as a rigid bridge across the defect, and the presence of periosteum supplies an osteogenic element. However, this graft is difficult to shape because of its extreme density and we limited its use to losses not involving the symphysis or angles. Nine such grafts were used in this series of cases, with only one failure.

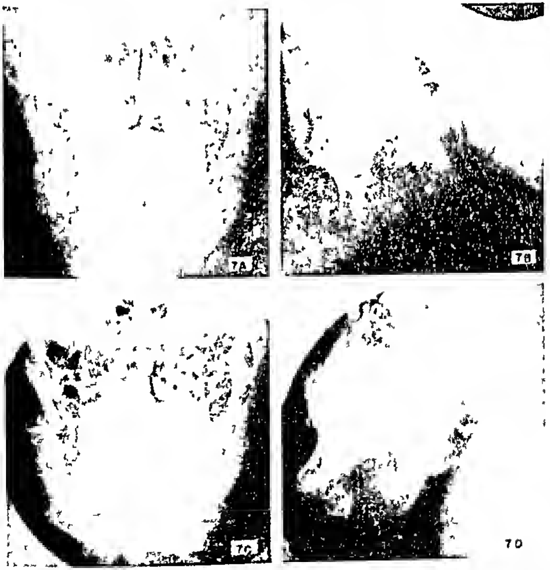
Rib grafts (Figs. 4a, 4b, 4c, 4d) or those obtained from the iliac crest can be used for all large bony defects of the mandible. One can secure large sections of bone from either site without producing a deformity of the donor area. Both grafts are relatively easy to work with and adapt themselves well to the contour of the mandible. We feel that the choice between them is largely one of personal preference. The inherent springiness of the rib graft sometimes presents a problem. When it is used to replace a major loss of mandible, there is occasionally a clinically demonstrable "give" in the lower jaw, most marked when the jaws are brought into occlusion. It is possible that in time the stimulation by mastication may produce enough additional calcification to overcome this disadvantage. Of the twenty-five rib grafts done at our center, four did not produce union. In these four cases there was resorption of a portion of the graft and replacement by fibrous connective tissue.

Grafts obtained from the ilium (Figs. 5a, 5b, 5c, 5d) were used in 22 cases of this series; five did not unite. An analysis of these failures is presented in Chart II. An iliac graft is easily obtained, readily shaped to any desired pattern and offers a good source of cancelous bone for replacement of a mandibular defect. After union occurs, there is adequate stability of the lower jaw. We made no



attached to

te osteoper-



FIGS 7a AND 7b X-RAYS ILLUSTRATING MASSIVE LOSS OF BODY OF RIGHT MANDIBLE
FIGS 7c and 7d Appearance of mandible after reconstruction with tibial block graft.

attempt to decorticate these grafts, except insofar as cortex was removed in the process of shaping.

Operative Technic. Nitrous oxide-ether combination, administered through a nasotracheal tube, was the anesthetic routinely used. The plane of anesthesia was kept relatively light and curare was used when it became necessary to obtain relaxation of the jaws for reduction of malposed proximal fragments.

Adequate exposure of the operative site is essential. Incisions along the lower border of the mandible were made long enough to permit adequate exposure of the defect and the fragments of the proximal and distal ends which required preparation. In the cases with minimal bony defects, there was often sufficient platysma muscle left to permit separation of the fibers and re-approximation

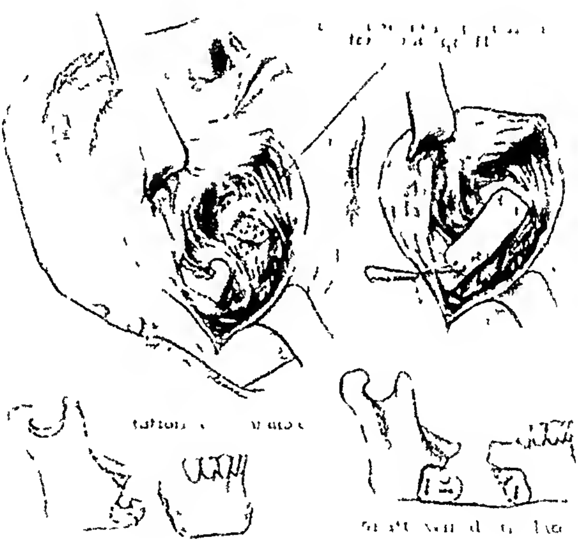
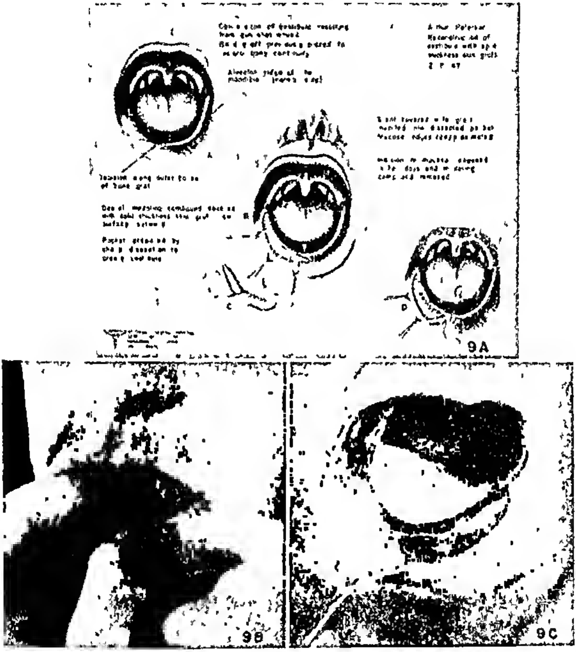


FIG. 8. Schematic drawing to illustrate operative technic of bone graft to mandible.

after placement of the graft. In most of the cases, however, the platysmar was replaced with scar tissue. In these we mobilized the scar and remnants of platysma to form an immediate soft tissue covering for the graft. Scar overlying the bony fragments was completely excised. Dense fibrous tissue in the area of defect was removed in order to prepare an adequate vascular bed for the graft.

Considerable attention was given to adequate preparation of the ends of the proximal and distal fragments (Fig. 8). It is essential that as large an area as possible of active bleeding bone be in contact with the graft. Generally, the bone ends and graft were beveled; in some instances a mortise joint was used for greater stability.

Tantalum wire was used routinely to secure the iliac, rib or tibial block graft. Two wires placed through previously prepared drill holes in the graft and proximal and distal fragments were considered essential for adequate anchorage of the graft (Fig. 8). In the osteoperiosteal grafts, the thin layer of cortex with attached



rib graft.
FIG 9c Appearance of mouth after vestibule reconstruction with split thickness skin graft

periosteum was simply laid over the defect and adjacent freshened bone ends and tucked under the lower borders of the fragments

Control of bleeding was often difficult because of the extensive deep scarring. Persistence in ligating all bleeding points was found essential in preventing postoperative hematomata. The ligature material used was 5-0 catgut.

Careful handling of the tissues is as important here as in any other plastic surgical procedure. A meticulous dissection technic is necessary to avoid perforation into the oral cavity. Wound closure was accomplished by adequate undermining of flaps of skin and subcutaneous tissue and approximation without tension with 5-0 and 3-0 catgut. Superficially placed drains, left in position for 24 hours, were used occasionally, where complete hemostasis was questionable. A carefully applied pressure dressing was used routinely.

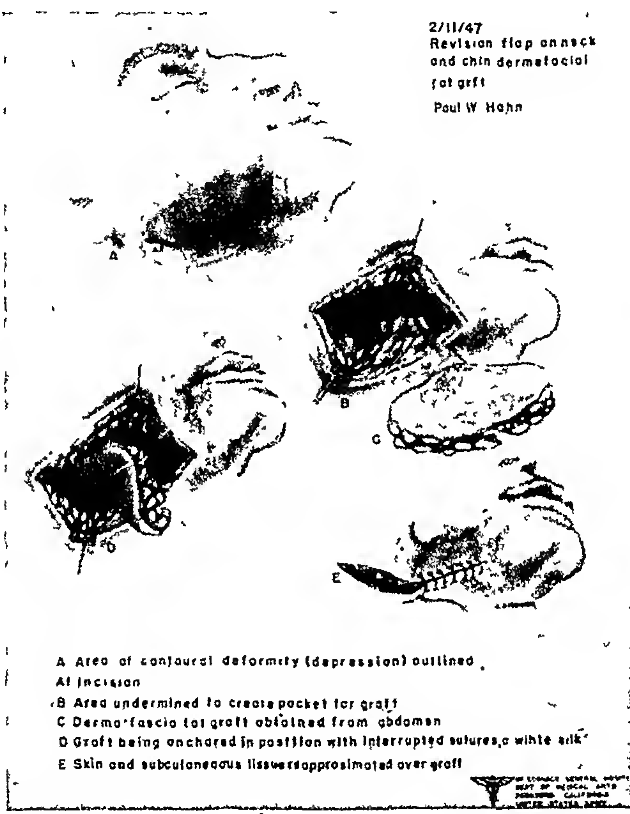


FIG. 10 Schematic drawing to show technic employed in repairing contoural defects of the face by dermal fascial fat grafts.

Post-Operative Care. For the first 24 to 48 hours after operation, these patients require constant observation and adequate nursing care. There is usually a marked secretion of mucus in the nose and throat, resulting from irritation by the nasotracheal tube. This is controlled by aspiration with a suction unit that is kept at the bedside constantly. Frequent turning is instituted to minimize the incidence of post-operative pneumonia. If respirations are shallow, carbon dioxide is administered to forestall pulmonary collapse. A pair of crown and bridge scissors is tied to a prominent place on the bed so that intermaxillary wires can be quickly cut to prevent aspiration if vomiting occurs. Nurses

trained and familiar with the post-operative care of this type of patient are a tremendous asset to the surgeon.

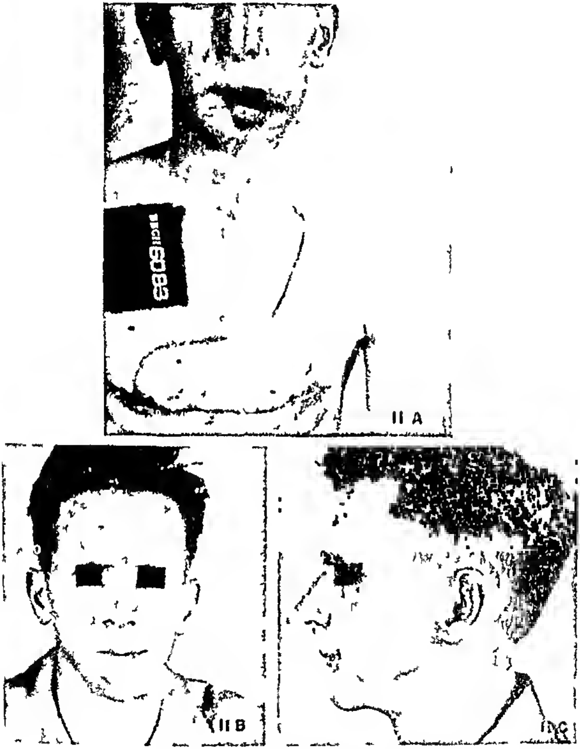


Fig 11a Gunshot wound resulting in massive soft tissue loss of lower lip and chin and
dible
er reconstruction of soft tissue with a neck-
ontinuity of mandible with iliac bone graft
Contour of chin restored with a preserved cartilage graft

As a prophylactic measure, penicillin and sulfadiazine are administered routinely for the first week after operation A high caloric liquid diet is started as soon as tolerated, prior to that water, salt and glucose requirements are fulfilled

by intravenous administration. The first dressing is done on the fourth or fifth post-operative day.

Preparation of Adequate Sulcus for Dentures. Following resotration of adequate continuity of the mandible, in many cases there was a minimal amount of disturbance of the anatomy of the vestibule. Dentures to replace necessary missing teeth could therefore be constructed without revising the buccal sulcus. Z-plasties were sometimes necessary to increase the depth of the sulcus in localized areas and to relieve bowstring contractures. Following repair of major bony loss, however, there was usually complete obliteration of the sulcus and it was necessary to use split thickness skin grafts to create an adequate vestibule. In some instances, dental modeling compound with a split thickness skin graft sutured around it was used (Figs. 9a, 9b, 9c). In others, the graft was sutured to the mucosal edges of the dissected pocket, using iodoform gauze saturated in balsam of peru as packing to maintain pressure on the skin graft. The results were uniformly excellent with both technics. After removal of the stent or packing on the tenth post-operative day, an acrylic splint was kept in place for several weeks to minimize shrinkage of the skin graft.

Denture Construction. Over and above the usual problems of lower denture construction, the prosthedontist was frequently called upon to improvise rather bizarre appliances because of the paucity and frequent malposition of the remaining teeth and the extensive loss of alveolar processes. The latter also made full denture construction difficult since a bone graft could never adequately simulate the normal anatomy of the alveolar ridges.

Restoration of Facial Contour. Patients with a major loss of the mandible usually had residual contoural deformities, even after bone grafting had been accomplished. Normal contour was restored by use of dermal fascial fat grafts obtained from the abdomen (Figs. 3d, 3e, 3f, 10). We over-corrected the deformity to allow for at least one-third shrinkage of the graft. Having followed a part of this group of patients for over a year, it is our opinion that maximum shrinkage occurs within the first three months. Several of the patients that required bone grafts in the region of the symphysis had residual contoural deformities of the chin. These were corrected by cartilage grafts (Figs. 11a, 11b, 11c).

CONCLUSIONS

A group of 92 patients requiring restoration of mandibular continuity were cared for on our plastic surgery service. A total of 106 bone grafts were required to accomplish these repairs. A statistical report of the results obtained is shown in Charts I and II.

We feel that grafts taken from the tibia, ilium or rib can adequately restore bony continuity of the mandible.

The important factors in effecting bony union of the lower jaw are: (1) Complete absence of residual infection; (2) Adequate splinting; (3) Adequate pre- and post-operative care; and (4) A meticulous surgical technic.

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POLYETHELENE IN RECONSTRUCTIVE SURGERY

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The search for substances suitable for implantation in reconstructive surgery is never ending. For many years the limitations of bone and cartilage implants have restricted the scope of plastic repair. This paper is concerned with the use of Polyethelene, a new synthetic material which has been implanted in the tissues with no untoward reaction to the host. First produced in Great Britain in 1936 and in the United States in 1943, the material has had a large commercial use.

The material was first used in surgery as fine tubing in continuous blood transfusions. Following this, Ingraham, Alexander and Matson used Polyethelene as a dural substitute in neurosurgery. Their work demonstrated a complete absence of foreign body reaction to Polyethelene in experimental animals. They also noted that Penicillin was not inactivated by the material.

The use of Polyethelene in reconstructive surgery was begun at this hospital nine months ago. Our experience has demonstrated the fact that Polyethelene is one of the few synthetic substances which can be buried in human tissues with very little reaction. This knowledge has led to the frequent use of this substance in facial reconstruction.

PROPERTIES OF POLYETHELENE

Polyethelene has one of the simplest chemical formulae of all plastics. It is chemically inert and resistant to most of the common solvents. It has a natural flexibility and pliability and requires no additional chemicals (plasticisers) to give it these properties. It does not adversely affect the body tissues and its physical properties are unaffected by the temperature ranges of the human body.

The material becomes amorphous at 115°centigrade but for practical purposes a temperature of 200° to 300° centigrade is needed to soften it sufficiently for molding into the required shapes. Sterilization is accomplished by soaking in 70% alcohol for a period of ten hours. It should be noted that commercial Polyethelene often has additional compounds added to alter various physical properties. Most of these compounds have been found to be noxious to the body tissues. For this reason only chemically pure Polyethelene has been used for surgery.

PREPARATION OF THE IMPLANT*

Since Polyethelene cannot be easily cut with a knife, rough forms are cut from blocks by means of a power saw. Final shaping and finishing is done by grinding with motor driven sandstone or emery paper wheels.

* The authors are grateful to Mr. Warren E Peterson of the Bakelite Company for technical information and for obtaining pure Polyethelene for these cases.

It is fairly easy to cast the material to desired shape A wax model is made of the desired implant This model is then invested in artificial stone The wax is removed from the investing mold and the negative filled with Polyethelene granules and heated to 300° centigrade Pressure is then applied to the mold and maintained until cooling has occurred

In the operating room, minor adjustments in size and shape and contour may be made by use of dental stones and burs The burs, stones and the dental hand piece are sterilized while the dental machine is covered with a sterile sheet Thus exact structure may be obtained in the couse of the surgical procedure

The surfaces of the material are roughened to allow better adhesion to tissue When large segments are employed, multiple holes are drilled to permit fibrous ingrowths which give additional fixation

NASAL IMPLANTS

At present writing, L shaped Polyethelene struts have been employed in elevating the nasal bridge in six cases The struts which had previously been cut from blocks were trimmed to final size and shape at the time of operation and were inserted through a mid columellar incision In three cases excess nasal bone was removed by chisel and the struts immediately inserted The post operative reaction has been considerably less than that seen following cartilage insertion No twisting, warping or other irregularities have been noted See figure 1 (a to d)

In one case of marked nasal deformity secondary to cleft lip, there was a considerable amount of excoriation of the skin due to total absence of columellar support and a complete collapse of the nasal tip This patient developed signs of local infection post operatively and upon aspiration of the site of implant, purulent material was obtained from which staphylococcus aureus was cultured This complication was treated by aspiration of the exudate and instillation of Penicillin combined with the parenteral administration of Penicillin All signs of infection subsided within a period of 6 days and the strut was retained intact If the implant had been cartilage, complete loss of that material could have been expected

CHIN IMPLANTS

Polyethelene implants have been used for the correction of receding chins in six cases The case in which the most extensive implant was used is illustrated in figure 2 These implants have been inserted through submental skin incisions The inserts have varied in size from very small ones to the large one illustrated Each chin piece had multiple holes in it and each was sutured to the periosteum of the mandible The Polyethelene was firmly adherent in a period of three weeks

FOREHEAD IMPLANT

One segment 2 0 cm by 4 0 cm was used for a skull defect in the forehead with excellent functional and cosmetic results

a b c d

FIG 1 Photographs of Polyethelene nasal strut implant Patient had a submucous resection performed at age of five following injury in auto accident The resultant deformity at the age of 22 can be seen in Figures a and c There was a complete absence of any septal cartilage The alar cartilages were depressed and distorted Difficulty in breathing could be relieved by test elevation of nasal tip

Figures b and d show post-operative pictures 3 weeks after implantation of nasal L-shaped strut This was implanted after a dorsal section of nasal bone was chiselled off The strut rests on the bony dorsum and on the nasal spine This carly picture is being shown to demonstrate the minimal post operative reaction

EAR RECONSTRUCTION

The final word has not been said on total ear reconstruction. Preliminary results in one case have led us to believe that Polyethelene may be a useful aid in future ear reconstructions.

Fig 2 Photographs … photographs a and c sho… plant at another clinic … section Although this … it to fit the mandible clos… methacrylate implant wa… serted. This piece confo… to the mandible It is now immovable. … all dressings except supporting collodian

A Polyethelene form with multiple perforations and a rough surface was made. The shape was a gross exaggeration of a helix and anti-helix but no attempt was

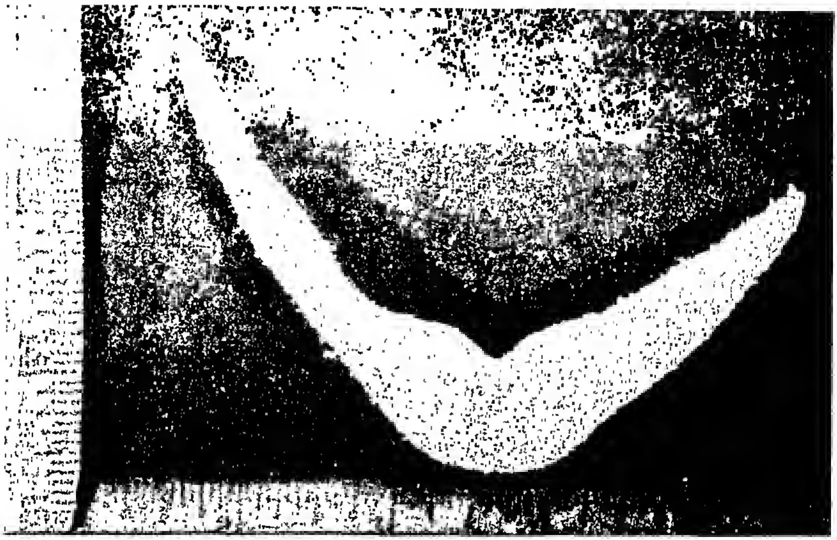

FIG. 2e

a

b

FIG. 3. These photographs demonstrate the use of Polyethelene for ear reconstruction. Figures a and b show pre-operative condition. Figure c shows neck flap with Polyethelene implant. This approach to reconstruction was subsequently abandoned due to technical difficulties. The implant was removed and the flap tubed. This tube is evident in subsequent illustrations. Figure d is the implant. Figure e shows condition 10 days following insertion of Polyethelene in a scalp flap. Figure f shows condition after Z-plasty. Figures g, h and i show condition after formation of post auricular sulcus by means of a split skin graft.

c d e f

Fig 3 c–f

made to form the posterior wall of the concha. The form was inserted under a post auricular flap and gentle pressure was made over the flap to make the skin adhere to all crevices The resultant scalp defect was covered by a split skin graft. When pressure was removed one week post-operatively the skin was ad-

g h i

Fig. 3 g–i

herent to the form and simulated normal ear contour Z-plasties have been employed to utilize vestigial remnants of auricular tissue and a post auricular sulcus has been formed by means of a split skin graft See figure 3

COMMENT

Clinical experience with a number of cases has demonstrated that Polyethelene is an excellent substitute for cartilage or bone It does not cause untoward tissue reaction nor is it adversely affected by the tissue It may easily be shaped by grinding, casting or sawing Its use is not limited by consideration of size or shape Its use in the nose has certain advantages over the use of cartilage It will not warp nor dissolve It rapidly becomes adherent, resists displacement, and produces less post-operative reaction than cartilage

The material permits extensive reconstruction of the chin There is no limitation to size and final definitive shape is achieved immediately In contrast to diced or ground cartilage, the post operative reaction is negligible

Our use of the material in ear reconstruction is limited to one case which is a yet incomplete Polyethelene has provided a thin flexible form to which the skin adheres One operation established the general shape Completion of the reconstruction should require relatively few subsequent stages Of great importance is the fact that Polyethelene is a poor thermal conductor This property obviates painful sensation upon exposure to cold and minimizes the danger of frostbite.

CONCLUSIONS

A new plastic material has been presented for use as implantations in facial reconstruction

The substance is chemically inert, has no unfavorable effect on the body tissues and is not unfavorably affected by those tissues. It is flexible and easily shaped and yet does not warp after implantation

A number of cases have been demonstrated which illustrate some of the uses of Polyethelene in reconstructive surgery

RECONSTRUCTION OF THE NASAL TIP: A NEW TECHNIC

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TYPES OF TIP DEFORMITY

Deformities of the tip can be divided into two categories, the bulbous type and the contracted type. Of the bulbous type, we may consider:

1. Two congenital forms
   a. The fleshy hypertrophy type.
   b. The normal integument type.
2. Traumatic varieties—under the traumatic bulbous deformity one has to consider the:
   a. Uneven bulbous deformity due to absorption or hypertrophy of one cartilage without involvement of the other, or,
   b. The restriction of growth resulting from deformity and the compensatory hypertrophy of the other, also,
   c. The hypertrophy of cartilage from the persistent blowing of the nose and manipulation.
3. Surgical variety—bulbous deformities that are the sequelae to nasal plastic surgery:
   a. A failure to do the tip surgery at the time of nasal reconstruction.
   b. Over correction of the tip due to use of the so-called mattress suture, or orthopedic suture.
   c. Too great a reduction in the bony and septal dorsum with resultant disproportion between the tip and the rest of the nose.

The contracted tip deformities may be divided as follows:

1. The congenital contracted type such as the deformity occurring in harelip.
   a. In contracted congenital failure of embryological or physiological development there will result contractures of equal or unequal proportions in related cartilages and similarly early trauma in childhood would cause analagous relationship with respect to cartilage contracture, or hypertrophy.
2. The postoperative contracted type—these are the result of:
   a. Unequal, unbalanced or surgical disproportion in the approach to the nasal tip problem proper, or,
   b. They are the result of cartilage absorption due to hematoma or infection. Further, contracted tips may be,
   c. The result of extensive faulty or disproportionate resection of the soft tissues internal or external. Such cases often require the grafting of cartilage, skin, mucous membrane flaps or even pedicle grafts.

STANDARD APPROACH

The intent of this article is to show that the approach to the problem of tip reconstruction remains practically the same in all procedures. Whether,

1 The tip deformites are the result of *bulbous-congenital, bulbous traumatic, bulbous post-operative deformity*, or,

2 The tip deformities are the result of contracture, either due to *congenital deformity contracture, traumatic deformity contracture or post operative deformity contracture* Whether the objective is *reconstructive* or *revision* per se or whether this revision or reconstruction requires cartilage grafting, mucous membrane grafting, flaps or pedicle flaps

A 1 A 2

EXHIBIT A 1 DEMONSTRATES TYPE 2 a b c OF AUTHOR'S CLASSIFICATION OF

SSIFICATION OF

by graft to the alar

TECHNICAL APPROACH

The author's technic is one based upon complete mobilization and skeletonization of the supportive structures of the tip and this must necessarily imply the covering soft tissues as well The cases requiring special consideration such as those treated with x ray or radium, those with tuberculosis, diabetic syphilitic, cancer or blood dyscrasia background must necessarily be excluded from the implications of this paper inasmuch as such cases imply a pathological background and require individual and special consideration The writer, however, accepts consideration of those cases in which the soft tissue and cartilage and other supporting structures are of the normal variety whether deficient or involved in scar tissue providing the scar tissue is of the normal variety as found as part of the normal reaction in normal tissues Again in those cases of marked

congenital disproportion and deformity as in the most severe cases of the cleft lip and cleft nose and harelip variety special consideration must naturally be given and these cases must be precluded from this discussion.

Author's Technic: A marginal incision is made within each naris. A second intercartilaginous and transcolumellar transfixing incision is also made if the case warrants. Dissection is carried out *extensively submucously* and *subcutaneously.* This method of *skeletonizing* the alar cartilages subperichondrially is also carried out on the upper lateral cartilages when and if necessary, carrying the dissection subperichondrially as far as the mucoperiosteum and periosteum of the nasal bones. Skeletonization is carried out in the direction of the septum to completely

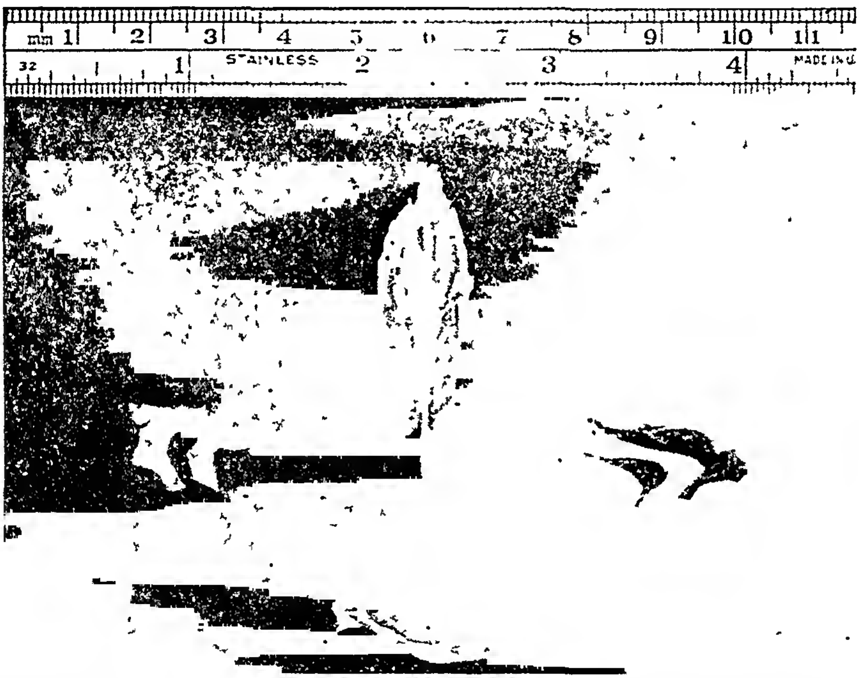

Exhibit A-3 To exemplify author's technic, Posterior view photograph of bone and cartilage resections in normal relationships as in vivo except for columellar (lateral) view *Note:* Skeletonization of ventral surface of bone, triangular cartilage and septum

visualize and skeletonize the *septocartilaginous juncture* of the upper cartilage. The dissection of the alar cartilages is carried out laterally as far as their attachment to the connective areolar network holding the cartilage to the pyriform aperture. If there is deformity, angulation or protrusion of the medial crura of the alar cartilages, then dissection is carried out liberating the medial crura completely so that resection can be made to proportion.

SICKLE-SHAPED ALAR CARTILAGE RESECTIONS

To Gordon B. New credit is given for the sickle-shaped pedicle flaps utilized in reconstruction of the nose for subtotal or total losses. The writer has adopted

the term *sickle-shape* to describe the *resections* of the lower lateral cartilages or alar cartilages inasmuch as this term *sickle* most logically describes the shape of

1

2

3

4

EXHIBIT B-1. PREOPERATIVE VIEW TYPE A OF AUTHOR'S CLASSIFICATION OF CONGENITAL BULBOUS NOSE
EXHIBIT B-2. POST OPERATIVE VIEW DEMONSTRATES RESULT OBTAINED BY AUTHOR'S TECHNIC OF SKELETONIZATION AND MOBILIZATION
EXHIBIT B-3. PREOPERATIVE VIEW DEMONSTRATES TYPE (a) OF AUTHOR'S CLASSIFICATION OF CONGENITAL BULBOUS NOSE WITH PROMINENCE OF THE NASAL TIP AND BONY DORSUM
EXHIBIT B-4. POSTOPERATIVE VIEW DEMONSTRATES PROPORTION AND SYMMETRY OBTAINED BY AUTHOR'S "SICKLE SHAPED PATTERN RESECTION" TECHNIC AS PART OF A GENERAL RHINOPLASTIC PROCEDURE

the segmental resections performed on the alar cartilages by the writer. Reference to fig. 1 of the rhinoplastic technic shows the alar cartilages delivered com-

pletely skeletonized for equalization and also shows primary and secondary resecitons of a sickle-shaped appearance.

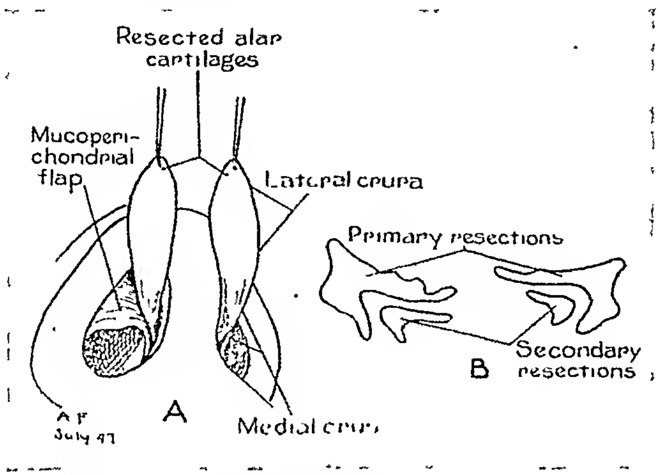

FIG. 1. A. SKELETONIZED ALARCARTILAGES RESECTED TO PROPORTION. B. SICKLE SHAPED ALARCARTILAGE RESECTIONS

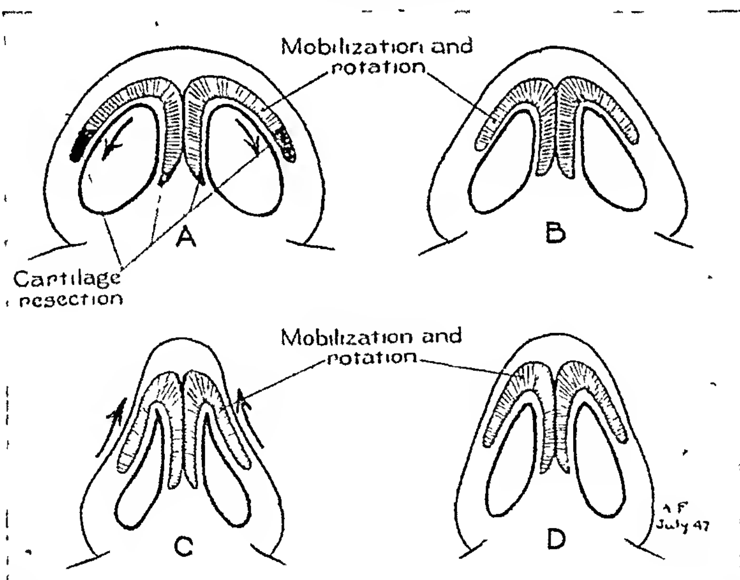

FIG. 2. TIP RECONSTRUCTION: A. METHOD OF NARROWING BULBOUS NOSE. B. A METHOD OF WIDENING NARROW NOSE

Figure A. It can be readily seen that the alar cartilages have been delivered, have been equalized as to length and as to height. Also it can be easily seen that

the medial crura are easily approached. The mucoperichondrial flap has been deflected sufficiently so that the cartilages have been completely mobilized.

BULBOUS VS. NARROW TIPS

The above procedure of skeletonization of the alar cartilages permits greater flexibility in the *development* and *repositioning* of the cartilages and in the reshaping of deformed or distorted tips. Once the sickle-shaped resections of the lateral crura of the alar cartilages have been made and similar but smaller corresponding resections of the posterior medial crura of the alar cartilages have been made then

C-1 C-2

EXHIBIT C-1 BULBOUS VS: NARROW TIPS BEFORE AND AFTER RESULTS OF CASE. PREOPERATIVE VIEW OF CONTRACTED OR NARROW TIP. Compare with Fig. 2C
EXHIBIT C-2 POSTOPERATIVE VIEW OF NARROW TIP WIDENED BY AUTHOR'S TECHNIC. DEMONSTRATION DRAWING 2D Note improvement in general facial proportions

it is possible to completely reposition the alar cartilages beneath the dome or crest of the nose and maintain the structural support of a newly-modelled tip. Reference to fig. 2 shows the resections as applied to the lateral and medial crura. Fig. A. In a bulbous tip. Fig. B. Shows what has been accomplished by a rotation of the lateral crura medialward without severing or incising the alar cartilage at the anterior angle of the naris. Fig. 2 C. Shows what can be accomplished with reference to a narrow tip. In this case section of the lateral crura was not necessary and rotation of the cartilage was utilized to give greater width to the crest or dome of the tip. Rotation of the alar cartilages *can not be accom-*

plished by any other means than with the use of complete skeletonization, (except for partial fixation of the medial crura in its middle third). This permits a repositioning and maintenance of this repositioning with transfixing sutures of silk which maintain the cartilage in the desired position. It must be emphasized that the angle between the medial and lateral crura of the lower or alar cartilage can be reduplicated as nature would make it by excising sufficient of the lateral crura to maintain the advanced or rotated lateral wing at the normal columellar crural height. Reference to fig. 3 demonstrates the number of sutures necessary to close the marginal and intercartilaginous wounds and also clearly shows the fixation sutures applied to the repositioned cartilages. Assumption has been made that the tip correction alone was a necessary consideration in this article without reference to septal or dorsal bone deformity.

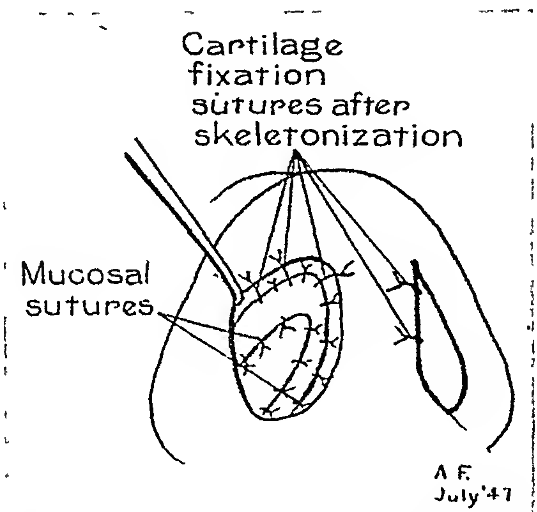

Fig. 3. Tip Reconstruction. Showing Wound Closure after Skeletonization, Mobilization and Resection

PROPORTIONING TIP

In the event that the repositioning of the alar cartilages is insufficient either in the reduction of the septal or bony dorsum or in the elevation of the septal or bony dorsum then the problem must be analyzed further. Consideration must be given to adequate and proportional resections of the caudal end of the septal cartilage as well as the distal edge or septal edge of the upper lateral cartilage. In any case, an attempt must be made to harmonize the height of the tip with that of the bony and septo-bony structure of the nose or to harmonize the septo-bony structure to the height of the tip.

RESUMÉ

The mobilization of the lower lateral cartilages and their rotation inward can be utilized to advance the nasal tip, give it prominence and at the same time

narrow the nostrils or nares without the need to develop a longer columella from the lip In cleft lip repair, when no rotation of the lower lateral cartilage is done but instead a V to Y advancement of the lower lip, the restriction of the lower lateral cartilage still exerts its influence on the depression of the tip This is managed much better by a complete mobilization of the mucous membrane and the mucoperichondrium of the inner nose or lining from the vault of the cartilage and by the mobilization of the mucoperiosteum from the bony roof The procedure advanced by the writer does away with lip scars and results in a borrowing of neighboring tissues by mobilization through hidden scars or rim scars Columellar scars per se would restrict the anterior advancement of the tip and should be avoided as growth takes place

CONCLUSIONS

There are many ways of reconstructing the lower or alar cartilages Each method has its particular merit when applied in the specific case for which it was intended, however, as a routine procedure some methods have advantages over others The author's procedure offers a distinct advantage over many procedures inasmuch as there is little sacrifice of cartilage and there is mobilization of the residual framework for support In addition this procedure is applicable in all types of tip corrections and consists of the following five steps incision, skeletonization, mobilization, resection of sickle shaped cartilage patterns, and, fixation by suture

The writer wishes to emphasize that only by skeletonization technic, which permits of anatomical visualization of the structural and supportive anatomy of the nose, both bony and cartilaginous, can the proper interpretation of the pathologic nasal complex be made Apropos the writer again emphasizes that corrective procedures and their successes are in direct proportion of this interpretation, all things being equal, viz , technical acumen, skill and training

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FIG. 1. ANTERO-POSTERIOR VIEW OF PATIENT AT TWO MONTHS OF AGE

FIG. 2. LATERAL VIEW OF PATIENT AT TWO MONTHS OF AGE

Fig 3 Lateral Radiographic View, Just Before Operation

Fig 4 Anteroposterior Radiographic View

apparently normal baby excepting for a soft swelling in the left cheek centering just above the angle of the jaw. This swelling was described as fluctuating, about the size of half a golf ball, and was thought to pulsate by some. As the baby increased normally in size from day to day the swelling grew rapidly larger. When he was six weeks old x-ray studies were made with the diagnosis of "dermoid cyst" (Figs. 3 and 4). One of us (L. C.) was called to see this child on October 21, two months after its birth, and was confronted with a picture whose likeness he had never seen in actuality or in print (Figs. 1 and 2). The baby was transferred to the Presbyterian Hospital the following day. He now weighed 12 pounds,—the mass protruding from his left cheek and neck was 13½ inches in diameter and bulged into the mouth and upper part of the pharynx. It was filled with a fluid that tiansmitted light and showed a network of distended blood vessels in the skin. We could feel no pulsations but there were peculiar twitchings now and then in the mass. The aspirated fluid was as clear and colorless as spring water with a mononuclear cell count of 12 per cc. and a very low protein count. Our pathologists indicated the fluid as being either pure lymph or cerebrospinal. We asked two other surgeons, Doctors Ivy and Eliason to look at this curiosity and they believed it was a cystic tumor, possibly a teratoid of parotid origin. They felt suspicious of malignancy, as we did, because of its rapid growth and that surgery was indicated. Our radiologist made some studies of the mass, —his diagnosis was a "probable cystic teratoma—lymphangioma to be considered".

At birth the baby's blood count was as follows: hemoblogin 85; red cells 4,200,000; white cells 15,000 with 71 per cent neutrophils. On September 24, one month after birth, the count was hbn 48; rbc 2.8; wbc 8,000 with but 45 per cent neutrophils and the rest monocytes. On October 22, the date of admission to the Presbyterian Hospital, the hbn was 63; rbc 3.3; and wbc 12,000. No differential count was recorded. On October 25 he was given 100 cc. of whole blood; this was repeated on the 27th, and, on the 28th, the day of operation, the count was hemoglobin 83; red cells 4,200,000 and white cells 10,000.

The operation took nearly two hours and the baby came through the ordeal in excellent condition because of the skill of Doctor Haugen, our anesthetist and his assistant, Doctor Turner. Following vinethene induction a tube was passed into the trachea and ether uscd. Sixty cc. of whole blood and 180 cc. of 5 per cent glucose in saline was given intravenously during the operation.

An incision was made over the base of the cystic mass from the lobe of the ear to the corner of the mouth. Immediately under the skin was the cystic sac from which 30 cc. of clear fluid was withdrawn to relieve the tension on the skin. The sac and the skin were easily separated upward toward the oral cavity at which point the mass became more solid the further we went. The rcmoval of this mass simply took time and carcful scparation from the surrounding tissues,—a good deal of the time the lines of cleavage were, apparent but not so clearly as we approached the sphenoid bone. The zygoma was pushcd upward and outward by the mass but its periosteum was intact. The portion which bulged into the mouth and upper pharynx was cystic and the sac and mucous membranc of the

oral cavity, which is very thin in a baby, was separated with some difficulty but, fortunately, the mucous membrane remained intact so there was uo future complication of infection from the mouth into the cavity occupied by the tumor. As we approached the sphenoid bone, to which it was attached, the mass was covered with small cystic areas much as a bull frog's eyes bulge from his head. The lower part of the tumor occupied the pterygo-mandibular space and was pressing upon the horizontal and ascending rami of the lower jaw but not adherent to the periosteum. Once delivered from within the head it was a simple matter to cut through the skin in the neck and suture the free edges of the skin together. A rubber drain was inserted into the cavity iu the face and cheek and a pressure dressing of cotton waste applied (Fig. 5).

This tumor involved all the tissues of the cheek,—subcutaneous, muscle, fat etc. excepting the skin so that with its removal most of the fibers of tho 7th nerve

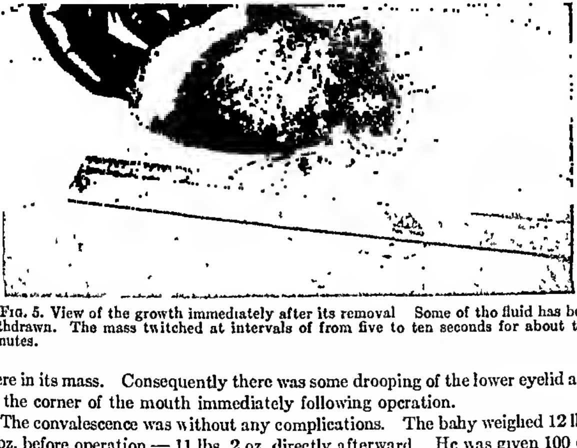

Fig. 5. View of the growth immediately after its removal Some of tho fluid has been withdrawn. The mass twitched at intervals of from five to ten seconds for about two minutes.

were in its mass. Consequently there was some drooping of the lower eyelid and of the corner of the mouth immediately following operation.

The convalescence was without any complications. The baby weighed 12 lbs. 8 oz. before operation,— 11 lbs. 2 oz. directly afterward. He was given 100 cc. of whole blood on November 8,—11 days after the operation and, within that time, 1,600,000 units of penicillin by muscle and 10 drops of eskadiazine in each feeding formula. Ho was discharged on November 19, 28 days after his admission, with a hemoglobin of 87; red cell count of 5,100,000 and a white cell count of 6,000 with 82 per cent of lymphocytes, said to be within normal limits by the pathologist. He weighed 11 lbs. 12 oz.

The pathological report in part: the tumor as removed intact with its fluid weighed 470 grams,—added to this the weight of the 30 cc. removed before operation would total the weight at about 500 grams No accurate measurement was mado of the amount of cerebro-spinal fluid in the cystic part but it was estimated

FIG. 6. PHOTOMICROGRAPH SHOWING SEBACEOUS AND SWEAT GLANDS

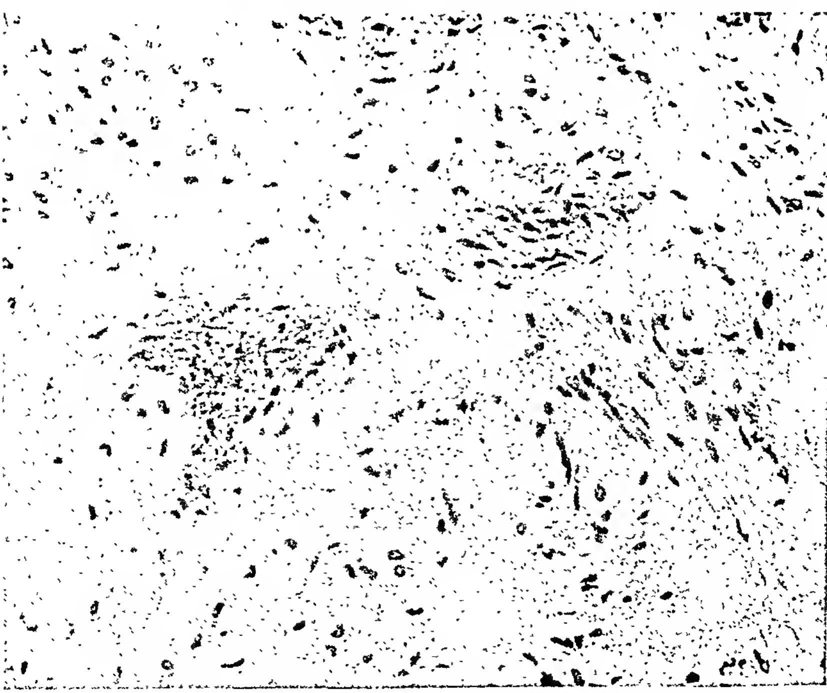

FIG. 7. PHOTOMICROGRAPH SHOWING BRAIN TISSUE

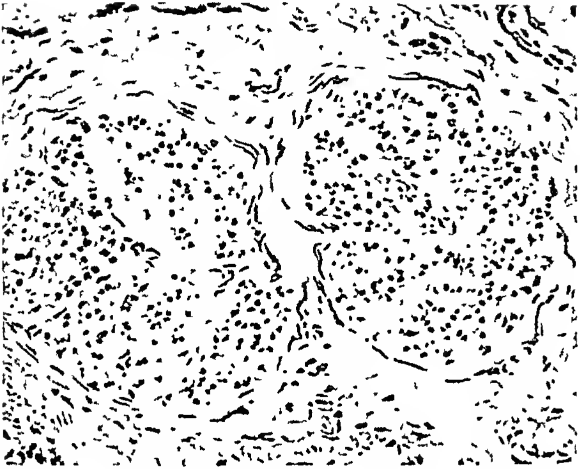

Fig 8 Photomicrograph Showing Nerve Buds

Fig 9 Photomicrograph Showing Breast Buds

FIG. 10. PHOTOMICROGRAPH SHOWING BONE

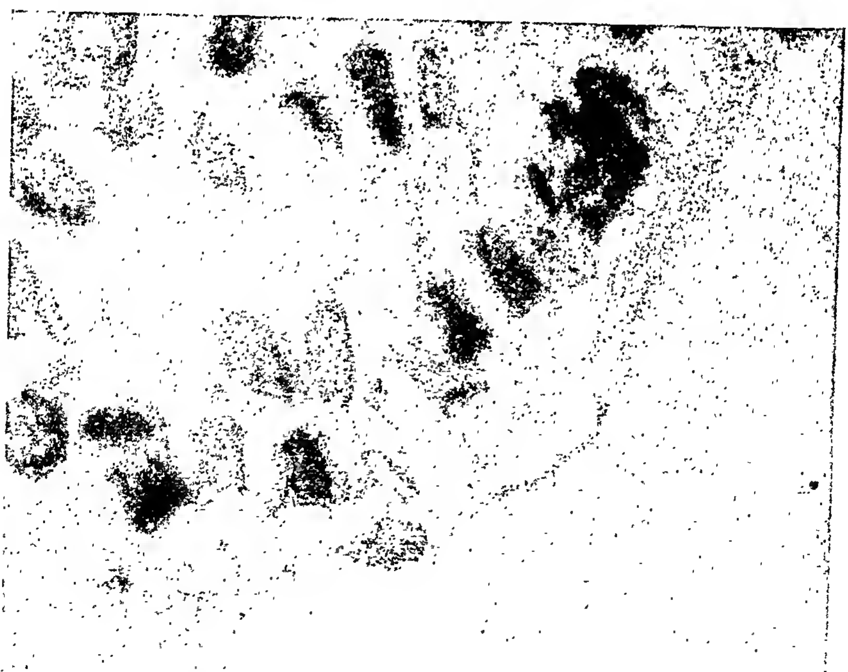

FIG. 11. PHOTOMICROGRAPH SHOWING CILIATED EPITHELIUM

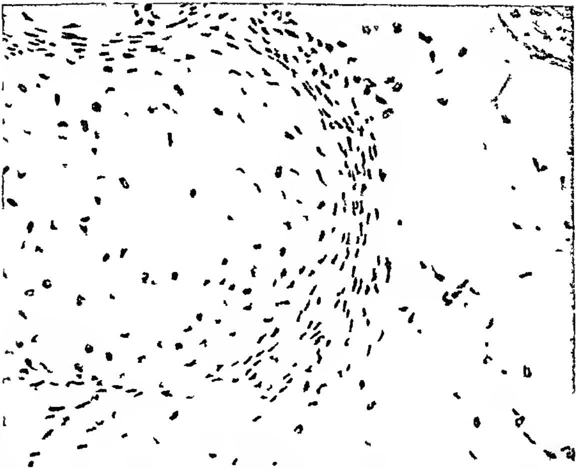

FIG 12 PHOTOMICROGRAPH SHOWING CARTILAGES AND FAT
(Photomicrographs made by Dr Donald E Barker)

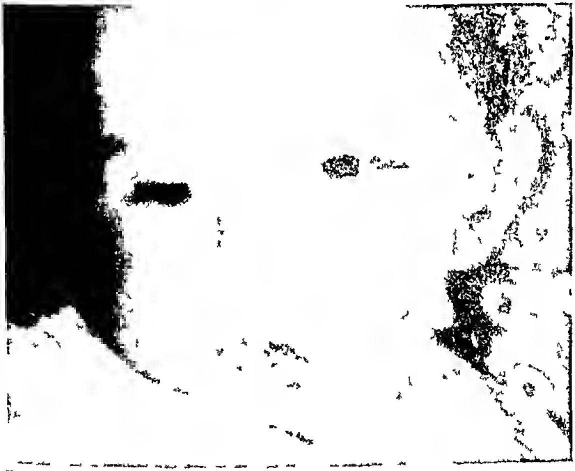

FIG 13
lids, the lef
the cheek is

to be about 350 cc. The microscopic description: "sections show a composite tumor in which the following tissues are represented: brain, with a well developed choroid plexus, a space lined in part by respiratory type of ciliated epithelium and in part by squamous epithelium, as well as a plaque of cartilage resembling tracheal rings, voluntary and smooth muscle, fat, fibrous tissue, sebaceous and sweat glands and bone with marrow spaces containing hematopoietic tissue (Figs. 6–12). There is no evidence of malignant quality to any of the components." The diagnosis: "Cystic Teratoma of Parotid Region."

On January 15, 1948 the baby weighed 16 pounds,—the left side of the face is filling out (Fig. 13) and the lower lid of the eye closes, although slower than that of the right side. There was some epiphora. At the time of this writing, May 12, 1948, little Eddie weighs 20 pounds,—walks well, the "tearing" of the left eye has stopped and the Mother tells me that the left corner of the mouth droops but very little and the left cheek is gradually filling out. He appears to be perfectly normal mentally,—and physically, with the exception of the area which has been under discussion.

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CHRONIC FISSURE OF THE LOWER LIP

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Chronic fissure of the lower lip is generally considered to be a rather inconsequential and benign type of lesion The possessor of this rather simple lesion, however, finds it a constant source of embarrassment because of its appearance and the presence of occasional bleeding and crusting The soreness and inflexibility are factors contributing to disability in function of the lip The fissure may be a source of constant discomfort because of continued inflammatory reaction, tenderness and occasional additional tearing or splitting of the tissues The open fissure may serve as a portal of entry for various pathogenic organisms The lesion also carries malignant potentialities

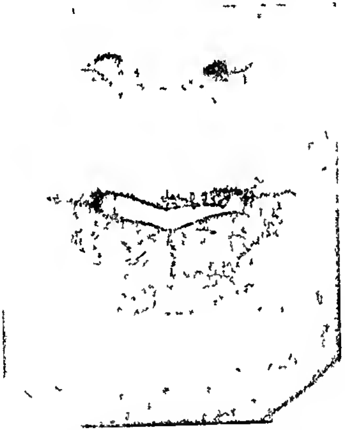

FIGURE 1 CHRONIC FISSURE OF THE LOWER LIP

The condition is most frequently seen in males and it is generally a seasonal defect, being present most often during the winter It is not infrequently noted in the female, however, and may be seen in either sex during periods of long exposure to the elements, even during the summer months The usual treatment consists of the application of ointments and more recently the ingestion of large amounts of vitamins Both of these measures are usually ineffective as far as a permanent cure is concerned The more stubborn cases eventually become

are outlined as shown in Fig. II. The incisions include the excision of scar and fissure to the depth of normal submucosal tissue and also the outlining of a Z in order to give additional length in the sagittal plane. Fig. III shows the line of closure on the vermilion and the mucous membrane surface of the lip immediately after surgery. Fig. IV shows the additional fullness of the lip obtained by means of excision of the fissure and the Z plastic procedure. Fig. V shows the healed condition of the lip three months following surgery. It will be noted here that there is sufficient bulk of tissue in the midline and the scar has been offset in such a way that the contracture in the sagittal plane is reduced to a minimum. In this manner a good full lip is obtained with little probability of recurrence of the fissure.

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A TECHNIQUE DESIGNED TO PREVENT LATERAL CREEPING OF THE ALAR CARTILAGE IN THE REPAIR OF HARE LIP*

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Perhaps no congenital deformity is more unsightly and tends to make of the individual having it a social outcast than a hare lip Inasmuch as the condition occurs frequently it is of the utmost importance that the repair should produce as good a cosmetic and functional result as possible

In my collection of three hundred and eighty cases of hare lip operated upon since 1925, we have been able to trace its occurrence in the family in about eighty per cent of the cases Seventy six per cent of the cases were associated with cleft palate Of these all were of course complete clefts of the lip Twenty-four per cent were partial cleft lips but practically all of these were of such nature that in order to repair the nasal deformity associated with it, it was necessary to convert the partial cleft in to a complete cleft

In virtually all cleft lips there is an associated nasal deformity, which demands correction as much as the lip The deformity of the nose consists of an angulation and deviation from the mid line of the columella from the tip toward the sound side of the lip The nostril that is not cleft is usually displaced higher on the face and away from the cleft

The criterion of a good repair is not only the formation of a good upper lip but a pair of nostrils of the same size and on the same level of the face and whose axes run from the tip of the columella to the insert of the tips of the lateral alar cartilages

Perhaps the most common failure in the results of these repairs is a pulling laterally of the base of the newly formed nostril where the tissue below the tip of the lateral alar cartilage is sutured to the base of the columella to form the floor of the newly constructed nostril This lateral creeping is due to the pull of the facial muscles of expression when the baby cries, some of the sutures cutting through due to this tension caused by the pull of these muscles in the lateral direction

I have overcome this difficulty with the following procedure, at the finish of the repair The principle involved is simply the use of a stay suture to prevent the lateral creeping of the lower alar cartilage The procedure consists of passing a moderately heavy silkworm gut suture on a fairly large curved cutting needle through the septum on the side of the intact nostril through a soft rubber catheter whose calibre corresponds to the size of the reconstructed nostril and on through the alar cartilage near its tip A split shot is slipped on the suture on its septal side and crushed on the suture so that it will not slip and the suture drawn

* Read by title only—Forum on Fundamental Surgical Problems, American College of Surgeons, September 1947

FIG. 1

FIG. 2

Fig 3

Fig 4

laterally until the shot rests snugly against the septum. A split shot is slipped on the opposite end of the suture passed along the suture against the lateral aspect of the lower alar cartilage until a desired tension is secured and crushed in a similar manner on the suture. This short intranasal tube held in place by this stay-suture is left in place for seven or eight days. At the end of this interval, the undermined tissues are thoroughly anchored in their new positions. The tube and stay-suture are removed and the newly constricted nostril remains intact in its newly constructed form and position. This technique for holding the nostril until it is fixed in its new position has been used by me in over one hundred cleft lip repairs and I have found it very satisfactory. There has not been a single case where the shot resting against the septum has pulled through or ulcerated through the septum. The lateral shot against the skin surface has occasionally produced a small pressure abrasion but never deep enough to leave a scar. The technique used in these cleft lip and nostril repairs is patterned after Blair's modification of Mirault's technique with modifications to suit the particular case in hand. The measurements must be very exact and calipres and a steel rule are used in making these measurements. Needless to say a very extensive undermining of both nostrils as well as the columella is essential for success. Where there is a very wide separation of the premaxilla from the maxilla in the unilateral clefts manual pressure is used to force these bones to near approximation, the edges of the bones freshened and held in approximation by a tantulum wire suture.

In bilateral clefts with a protruding premaxilla, the vomer and septum must be resected and the premaxilla slipped backward much in the fashion that one would close a bureau drawer until it approximates the two maxillary processes where it is wired in place with a tantulum suture. In the repair of a bilateral hare-lip, it is my cutom to repair only one side at a time as the tension produced by a bilateral repair done at one sitting is usually so great that a considerable part of the repair will pull loose. I usually do the cleft lip repair at the age of six weeks if the babe is in good nutrition and the palate repair at the age of ten to twelve months. At the operation, the anesthetist scrubs and the ether anasthesia is maintained by blowing vaporized ether with oxygen through an ether hook placed in a corner of the babe's mouth or by a glass funnel held over and above the babe's face. A glass funnel is preferable as it can be seen through while working. The babes are all placed in extreme Trendelenberg position all through the operation and the throat is kept well cleared of blood and mucus throughout the operation. As a result of this technique of anasthesia being rigidly adhered to we have not had any cases of postoperative atalectasis or pneumonia.

SUMMARY

The use of this technique has prevented the postoperative development of the flat tent-like flap deformity of the nostril which occasionally occurs after a good nostril repair due to the giving way of the sutures placed in the floor of the nostril attached to the base of the columella.

TWO IMPROVEMENTS FOR THE DERMATOME

DAVID W. ROBINSON, M.D.

University of Kansas Medical Center

Within the past few months dermatomes with experimental features have been sent to me for trial.* The improvements are not mine, but two changes in construction are of distinct advantage and are worthy of a report

First, a drum made of aluminum instead of brass has been used Its chief advantage lies in the increased adherence of the rubber cement to its surface.

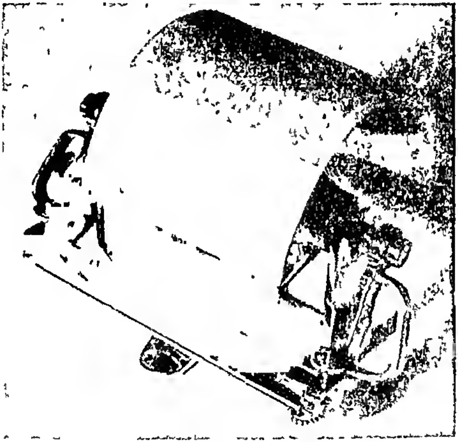


FIG 1

This adherence is so strong that the cement stays with the drum and almost none of it remains on the back of the skin graft There no longer is the problem of the free graft sticking to itself and no dusting powders are needed to prevent this disagreeable stickiness. The graft removed from the drum can be applied to donor areas by gloved fingers if desired. Furthermore, the drum itself is lighter

* These experimental models were submitted to me for trial by the Professor Emeritus ... s, George J Hood, who aided Dr ... I am in no way whatsoever con-

and easier to handle. In the thirty drums that I have cut with it I have found the aluminum drum to be of advantage over the older brass type.

Second, a different setting for the knife attachment has been tried sufficiently to demonstrate its increased efficiency over the standard arm bar clamp for the knife. The adjustable screws on either side to align the knife edge with the drum have been deleted. The new setting allows the knife blade to be slipped down to two stops, one on the extreme outer margin of each side of the arm bar. The blade is clamped to the arm bar by means of a long U-shaped bar clamp which holds the blade tightly in place without bowing or binding. The knife attachment is rigidly and accurately aligned mechanically so that the knife edge is .005 inches from the drum when the adjustable dial on the side reads zero. The knife never touches the drum and cannot have its edge dulled by contact. The adjustable dial can be moved only to widen the space between the knife edge and the drum and the operator can adjust the thickness for cutting at the desired depth. Further, the arm bar clamp is chained to the arm so that it cannot be forgotten and left elsewhere, an embarrassing event which has happened to me more than once with the free bar clamp of the present machine.

Mechanically, the change in the knife arm clamp with its single adjustment presents a distinct advantage to me, after cutting twenty-five grafts with it. There is a definite disadvantage. Should this accurately aligned mechanism be damaged as by dropping the dermatome on the floor, its repair might be difficult. It had occurred to me that should the extreme edges of the resharpened blade have unequal or untrue bevels, the knife edge might not evenly oppose the drum surface. With the bilateral alignment screws no longer present, such unevenness could not be compensated and a new or evenly resharpened blade would be needed for use; however, I had some old blades so sharpened with the bevelling definitely larger at one end of the blade than the other and found that this made no difference. The two stops on which the knife edge comes to rest are always the same distance from the drum so that the leading edge is always evenly separated from the drum.

PROGRAM

SEVENTEENTH ANNUAL MEETING

THE AMERICAN SOCIETY OF PLASTIC AND RECONSTRUCTIVE SURGERY

GREENBRIER INN, WHITE SULPHUR SPRINGS, WEST VIRGINIA

November 17th through 20th

Wednesday—November 17, 1948

8 30 A M to 9 30 A M —Registration

9 30 A M to 12 00 Noon—(Papers limited to 20 minutes)

Dr Hamilton Baxter	"The Role of Histamine in Thermal Burns"
Dr Edward A Kitlowski	"The Treatment of Callus with Skin Graft"
Dr Forrest Young	"Bone Cartilage Grafts for Saddle Nose"
Dr Clarence R Straatsma	"The Management of the Hypertrophied Nose Using Osteotomes"
Dr Gustave Aufricht	"Mammaplasty Pre operative Planning and Procedure"
Dr Jacques W Malniac	"Mammaplasty Development and Evaluation of Main Procedures"

2 00 P M to 5 00 P M —Recreation and Sports

5 00 P M —Executive Committee Meeting

Thursday—November 18, 1948

9 00 A M to 12 00 Noon —Problems of Rehabilitation

Moderator Dr Henry H Kessler

With Guest Speakers

2 30 P M to 5 30 P M —(Papers limited to 20 minutes)

Dr D McCullagh Mayer	"Depressed Fracture of Zygomatic Arch"
Dr Douglas W Macomber	"Cancellous Iliac Bone Grafts in Depressions of Forehead, Nose and Chin"
Dr Hector Marino (By invitation) Dr Nestor B Turco Dr Mario Craviotto	"Immediate Reconstruction of the Lower Jaw Following Surgical Excisions of Large Tumors"
Dr W B Macomber	"Mandibular Bone Grafts"
Dr T G Blocker, Jr Colonel Roy I Stout	"Mandibular Reconstruction, World War II"
Dr Carl W Waldron Dr Conrad I Karleen Dr Charles A Waldon	"Fundamentals in the Surgical Treatment of Mandibular Prognathism"
Dr Beverly Douglas	"Plastic Surgery of the External Genitalia"

7 00 P M —Cocktails

8 00 P M —Annual Banquet—(Members and Invited Guests)

Guest of Honor—Dr Vilray P Blair

"Various Uses of the Switched Lower Lip Flap in Secondary Hare Lip Repairs"

Sir Archibald McIndoe—Title to be announced

Presidential Address—Dr Neal Owens

Friday—November 19, 1948

9:00 A.M. to 12:30 P.M.—(Papers limited to 20 minutes)

Dr. Kerwin M. Marcks	"Repair of Defects Produced by Excision of Tumors in the Eye Region"
Dr. Wendell L. Hughes	"Metallic Implants and Integrated Artificial Eyes"
Dr. A. B. LeMesurier (By Invitation)	"A Method of Cutting and Suturing the Lips in the Treatment of Unilateral Cleft Lip"
Dr. W. H. Steffensen	"An Operative Repair for Unilateral Cleft Lip"
Dr. Claire L. Straith	"Single Hare-Lip Repair"
Dr. Bradford Cannon	"Direct Flap Repairs of the Extremities"
Dr. James Barrett Brown Dr. Frank McDowell Dr. M. P. Fryer	"Surgical Treatment of Radiation Lesions"
Dr. Beverly Douglas	"Deformities of the External Genitalia"

2:00 P.M. to 4:00 P.M.—Recreation Informal Presentation of Movies

4:00 P.M. to 6:00 P.M.—Annual Meeting

7:30 P.M.—Cocktails and President's Dinner
(Members, wives and guests)

Saturday—November 20, 1948

9:00 A.M. to 12:30 P.M.—(Papers limited to 20 minutes)

Dr. Joseph V. Caltagirone	"The Face—Artistic, Anatomical and Surgical Aspects"
Dr. Leon E. Sutton	"Hemihypertrophy of Face"
Dr. Robert H. Ivy	"The Repair of Cheek Defects Following Irradiation Necrosis"
Dr. Bernard N. Soderberg	"Surgical Methods for Soft Tissue Restorations about the Face and Jaws"
Dr. Herbert Conway Dr. Richard Stark	"Vascularization of Tubed Pedicles"
Dr. Charles F. Steiss	"Utilization of the Tube Pedicle in the Reconstruction of Facial Defects"
Dr. J. Wallace McNichol	"Total Helix Reconstruction with Tubed Pedicles Following Loss by Burns"
Dr. Ralph Blocksma (By Invitation) Dr. Joseph Kostrubala Dr. Paul W. Greeley	"Surgical Repair of Decubitus Ulcers in Paraplegics: Further Observations"

2:00 P.M.—Afternoon Free

September 1948

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

BURNS

Allen, Harvey S Local Treatment of the Whole Thickness Burn Surface *Surg Clin No America*, 125, Feb 1948

This clinical review of the local management of full thickness skin loss due to burns brings out several salient features which Allen has found useful The most important feature is the clearly defined objective to have all areas of complete skin loss covered with split grafts within 21 days after injury A rigorous plan and minute attention to detail are essential To accomplish the objective in the specified time necessitates primarily the removal of all slough between the time of the first dressing at 10 days, and 11 days later The methods used for débridement are (1) daily dressings with fine mesh gauze and pressure dressings, (2) chemical débridement with pyruvic acid starch paste, and (3) surgical excision followed by grafting 3 to 5 days later The method used is dependent upon the nature and the thickness of the slough

Chisholm, Tague C, and Hardenbergh, Esther Some Effects of Experimental Thermal Burns on Vascular Endothelium Employing a Perfusion Technic in Anesthetized Dogs *Ann Surg*, 27 75 Jan 1948

Chisholm and Hardenbergh reasoned that the multiplicity of experimental burn studies have resulted in much confusion due to varying species, methods of inflicting the lesions, and evaluating the end results Their objective was to produce primary burn injury to the endothelium of the vascular

tree of the hind extremities of dogs by perfusion with a gum acacia solution which was heated to varying degrees of temperature. The results were swelling, increased lymph flow and endothelial damage when the duration of perfusion was increased above 10 minutes at 50°, or at higher temperatures for shorter intervals. No specific toxic agent was demonstrated.

McCarthy, M. D. and Parkins, W. M.: Comparative Effectiveness of Albumin, Globin, Hemoglobin, Gelatin, Oxypolygelatin, Saline, Ringer's, Blood and Plasma upon the Survival of Rats Subjected to Standardized Scald Burns. *Am. J. Physiol.*, *150:* 428, Sept. 1947.

This study by McCarthy and Parkins was undertaken to evaluate fully, with a controlled reproduceable lesion in standardized white rats, the effectiveness of various infusion agents recommended for the treatment of burn shock. This project was well conceived, well planned, and clearly demonstrates its final results. It was found that hemoconcentration and plasma volumes were not critical values in determining survival rates. The most critical factors concerned with survival appear to be the sodium salts and fluid content. In fact, the efficacy of solutions other than saline cau apparently be predicted by their content of sodium salts.

Editorial Comment: This work will serve to clarify mauy controversial points in the management of burn shock, and when subjected to further clinical evaluation, will be a definite step in progress. It largely confirms the early clinical work of Fox and his associates as well as that of others.

HARELIP AND CLEFT PALATE

Blair, V. P., and Robinson, R. R.: Primary Closure of Harelip, Editorial. *Surg. Gynec. & Obst.*, *86:* 502, Apr. 1948.

Blair and Robinson make note of progress in the surgery to repair primary harelip. The essential aims of producing cosmetic symmetry and minimal scarring, together with free breathing, are now frequently attained. Children now grow to adulthood without obvious evidence of harelip repair.

Common errors have been excessive scarring, undue transverse shortening, asymmetry of the vermilion, and vestibular distortion.

Careful planning and precise measurements of the operative maneuvers are essential for a favorable result. There is an actual deficiency of the tissues in any harelip, complete or incomplete. This must be compensated for by planning. The required tissue is gained by mobilization of the lip, cheek, and nasal structures.

If the general condition of the infant permits, primary repair is done in the first few days of life. This presents the mother with a fairly normal looking infant, and lessens the unfavorable stigmata.

In the case of partial cleft lip, the undermining and mobilization of tissues may be limited, but if they are associated with nasal deformity, the extent of the mobilization must include the lower nasal cartilages. These are adjusted to the proper position.

When there is associated alveolar or complete bony cleft of the palate, these structures will be drawn in closer approximation after lip closure. The authors condemn the forceful approximation of bony clefts.

There are two basic plans for closure of the harelip, each with modifications. These are the Husson-Rose, and the Mirault operations. Vertical scars are prevented by beveling the lines of excision in such a manner that tissue tension will be on the deep sutures rather than those in the skin.

In complete double clefts of the lip and palate, lip closure is done in two steps. In the first step, the alae are adjusted and the lateral fragments of the lip are sutured to the prolabium. The septum is not shortened for fear of allowing the premaxilla to drift between the maxillae. After the pushback of the premaxilla is done, at the time of the hard palate closure there will be nasal snubbing. This is corrected by means of the trifoil advancement of the columella from the lip, thus raising the nasal tip.

A poor start in the plan of corrective procedures makes a final good result much more distant and uncertain than a few well-planned operative steps.

Marino, Hector: Surgery of Cleft Palate (Cirurgia de la fisura palatina). *Prensa med. argentina*, *34:* 2282, 1947.

Special emphasis is placed by Marino on

the physiological as well as the anatomic repair of cleft palate if good phonetic results are to be obtained

He advises repair at approximately one year of age, provided the general condition of the child permits In the case of lack of tissue, advanced age, or general debility contraindicating surgery, prostheses should be employed

Local infiltration of the operative sites with novocaine, combined with light general anesthesia, is advised Ether is given by the open method to young children, and by the endotracheal route to other patients

Sketches are presented, illustrating several operative technics, including Dieffenbach's lateral incisions, the push back maneuver, *et cetera* Marino stresses the importance of complete mobilization of the *mucoperiosteal flaps* to allow posterior displacement and good length The freshened edges of the cleft are coapted in layers—the nasal mucosa, mucoperiosteum, muscular, and aponeurotic planes Non absorbable sutures are used throughout the repair

The author employs postoperative immobilization of the palatal structures by placing iodoform gauze impregnated with balsam of peru in contact with the tissues This is held in place by cross wires attached to a dental appliance if teeth are present In edentulous patients, a heavy suture is placed through the nasal floor, one end in each naris, and tied outside the columella

HAND

Graham, W. C, Brown, J Barrett, Cannon, B and Riordan, D C. Transposition of Fingers in Severe Injuries of the Hand *J Bone & Joint Surg*, *29* 998, Oct 1947

In the reconstruction of the severely damaged hand, according to Graham *et alii*, scar tissue must be completely excised The closure of the resultant defect would require a pedicle flap In cases in which the long or ring finger has been amputated or in "dead finger," it is advisable to transpose the adjacent finger and its metacarpal to eliminate the defect The hand is narrowed by this procedure but its appearance and function are improved

When damage involves the tendon and bone of the ring or long fingers, scar and damaged metacarpal are resected to the base If the defect involves the ring finger, osteotomy is done on the fifth metacarpal near its base, this metacarpal is transposed to the base of the fourth metacarpal If the long finger is involved, osteotomy is done on the second metacarpal which is then transposed to the base of the third metacarpal

Sometimes the index finger is transposed to the first metacarpal to replace an amputated thumb The digit must be shortened, 1 or 2 inches of it are to function as a thumb and must be rotated almost 90 degrees Nerve and blood supply must be carried with the finger This requires splitting the digital nerve slip of the adjacent sides of the index and middle fingers well up to the base of the hand as well as freeing vessels necessary to allow transposition The result of the procedure is a thumb which will oppose the fingers, have normal sensation and have flexion and extension control

Transposition of the Index Finger to Replace the Thumb The operation is done in two stages

The first stage The scar tissue is removed through a dorsal approach The distal part of the second metacarpal is excised as well as the articular surface and ½ inch of the proximal phalanx of the index finger The transverse metacarpal ligament is sectioned, and the index finger is freed so that it will retract 2 inches The first metacarpal is shortened ½ inch and by rotating and retracting the index finger the first metacarpal and proximal phalanx of the index finger are brought in contact and fixed with stainless steel wire The wound is closed and an interval of 6 weeks follows

The second stage Division between the index and middle fingers is made The incision extends from the base of the palm to the base of the metacarpals dorsally A dorsal flap is then raised to fill the base of the cleft The vessels anastomosing between the middle and index fingers are freed leaving the blood supply to the index finger Cutaneous nerve branches to the index finger are freed The proximal pulley for the flexor tendon of the index finger is excised to free the tendons Extensor tendons to the index finger are rerouted to the radial side of the wrist The remaining exposed

surfaces are then covered with a split thickness skin graft taken from the thigh. Intrinsic muscles are left with the middle finger, and the abductors and adductors of the thumb are attached to the inverted index finger. The new thumb is held in abduction and apposition for 3 weeks. Scar tissue and the stump of old tendon are first excised. If necessary, pedicle flaps are used to replace scarred areas prior to tendon grafting. It is preferable to fix the distal end of the graft into the phalanx by the Bunnell pullout wire technic. The proximal end is also fixed with a Bunnell pullout wire or with silk sutures. In the base of the palm, the suture line is wrapped with the lumbrical sheath in a flexor tendon graft to the thumb, the graft is fixed proximally well above the wrist. Advanced atrophy sometimes makes it advisable to substitute a healthy muscle for motor powers by switching tendons.

After grafting, the hand and wrist are splinted for 21 days. Gentle active and passive motion are then instituted. After 4 weeks moderate resistive exercises are started, and in 6 weeks flexion against resistance is encouraged.

Freeing the flexor tendon graft more than 6 weeks after operation is important. If function does not return in 8 weeks, the prognosis is poor. Sometimes, operative tendolysis after 6 or 7 weeks will restore function. *Transposition to Replace Central Finger:* The line of incision depends on the scar tissue, but straight line incisions should be avoided in the palm of the hand. If a "dead finger" remains, it is amputated down to the base of the metacarpal, leaving $\frac{3}{8}$ inch of base. Adherent tendons are removed and damaged muscle are excised. Osteotomy of the metacarpal which is being transposed is done at the same level, and the metacarpal is moved over the base of the amputated metacarpal with its intrinsic muscle attached. The metacarpal is held in its new position by two Kirschner wires put obliquely into adjacent metacarpals. The rotation of the metacarpal must be accurately adjusted, and the metacarpal ligament must be repaired. Pressure dressing is applied, and the hand is supported for 3 weeks. At the end of 6 or 7 weeks, the Kirschner wires are removed.

Graham, Walter C.: Flexor-Tendon Grafts to the Finger and Thumb. *J. Bone & Joint Surg., 29:* 553, July, 1947.

Opinions derived from experience with 141 flexor tendon grafts are reported by Graham. Since loss of the flexor tendon in a finger handicaps hand function, the logical treatment is restoration of the flexor tendon function to the finger. If the tendon has been cut for a long time, the proximal end retracts, so that end-to-end suture cannot be done.

In this series, the tendon grafts were transferred without any attempt to preform sheaths. The graft was dissected from its donor site with the surrounding gliding mechanism intact. Tendons were not laid over bony surfaces, and pulleys were used at sites where there might be a bowstring effect.

It is difficult to restore flexor tendon function in the little finger. An extensively scarred finger or one with impaired sensation is not amenable to grafting. As a rule, the sublimis tendon is excised and the profundus tendon controls the distal joints of the finger. The stump of the sublimis tendon is fixed across the proximal interphalangeal joint into the proximal phalanx. The joint is then held in 10 degrees of flexion, which prevents hyperextension of the proximal interphalangeal joint. If the laceration is distal to the proximal interphalangeal joint, the sublimis function is retained and the graft is extended from the distal phalanx to the stump of the profundus tendon.

The polinaris longus is the most accessible graft. Excised sublimis tendon may be used. Other donor sites include the large tensor tendon of the toes, the peronius longus plantois tendon.

The suture site of the tendon graft should never be between the proximal interphalangeal crease and the distal palmar crease. Distally the graft may be sutured to the profundus stump or into the distal phalanx. Proximally, the suture line should be in the base of the palm or above the wrist.

Langston, R. G., and Badre, E. J.: Dupuytren's Contracture. *Canad. M.A.J., 58:* 57, Jan. 1948.

The data presented by Langston and Badre

are based on the completed operative procedures used in 88 cases of Dupuytren's contracture Operations were performed at the Veterans' Hospital and all the patients were male

The anesthetic of choice for the operation is stated to be brachial plexus block The type of incision favored is an incision along the distal palmar crease starting from the base of the index finger and extending to the ulnar side of the hand The second incision is along the proximal palmar crease around the base of the thenar eminence, proximal to the attachment of the tendon of the flexor palmaris longus to the palmar fascia If necessary, further incisions are made along the ulnar side of the fifth finger

The success of the operation depends on the primary healing of all incisions The complete removal of all fascia is paramount Hemostasis is important If at all possible, grafting should be avoided If a graft is used, the graft skin flap suture line should not be longitudinal to the long axis of the hand To overcome this, a diamond shaped defect is formed regardless of the amount of good skin that may have to be sacrificed The transverse axis of the diamond should be greater than the vertical axis

A pressure dressing is left in place postoperatively for 10 to 14 days, at which time physiotherapy is instituted

In elderly patients, Langdon and Badre advise amputation of a finger or fingers if necessary, instead of resorting to skin graft This amputation should be undertaken at the time of the initial operation

MALIGNANT LESIONS

Amersbach, J C Metastatic Basal Cell Epithelioma Report of a Case *Arch Dermat & Syph*, *56* 172, Aug 1947

A careful search of the literature by Amersbach revealed few cases of metastatic basal-cell epithelioma Most of the cases reported as such later proved to be of the basal squamous type There are, however several cases which are generally accepted as metastatic basal cell epitheliomas and a number of others which are thought to be possible cases of metastatic basal cell epithelioma

The author reviews the few cases of proven metastasis of basal cell epithelioma In one case there were indications that the metastases were blood borne

The case reported by Amersbach is the only one on record in 16 years of service at the New York Skin and Cancer Unit of the New York Post Graduate Medical School and Hospital A woman aged 39 had a lesion of the scalp which began 8 months previously following a burn from a permanent wave machine Biopsy showed infiltrating basal cell epithelioma The lesion was destroyed by curettage and electrodesiccation Four months later a recurrent nodule was removed with the same diagnosis Six months later two more nodules were removed Two months after this a lump behind the left ear was biopsied with a pathological diagnosis of infiltrating disseminated basal cell epithelioma About 6 weeks later radical excision and plastic repair with skin graft was done by Dr Zimany

The author feels that this is one of the rare instances of metastatic basal cell epitheliomas Sections through the entire lymph node revealed nothing which was reported as mixed, spindle or squamous in type

Traenkle, H L Problems Encountered in the Treatment of Cutaneous Cancer *New York State J Med* *47* 2414 Nov 1947

The treatment of those types of cutaneous cancer in which a routine treatment scheme may not be successful or satisfactory is discussed by Traenkle Cases are presented to illustrate some of the difficulties encountered in the treatment of cutaneous cancer

There is frequently a limit to the cosmetic correction that can be expected with plastic surgery in the cancer patient The large amount of tissue which must be removed often makes the mechanics of cosmetic correction extremely difficult The greatest disadvantage of radical destructive surgery on the face is the long term disability the multiplicity of reconstructive operations and the great expense which may be encountered In such cases other methods may be more practical from the economic standpoint This must be remembered in considering cases for reconstructive surgery

The cartilaginous structure of the tip of the nose does not tolerate irradiation or electrosurgery as well as the soft tissues. Also, scalpel resection is not so easily done in this area without considerable cosmetic distortion. The ear is secondary only to the nose as the site for the development of cancer that presents therapeutic problems. These problems are due chiefly to the irregular contour of the inside of the concha, making irradiation mechanically difficult, and also to the thin layer of skin and subcutaneous tissue over the cartilage, which tolerate irradiation poorly. In the concha, electrocoagulation is applicable only to small epitheliomas. Larger lesions, especially squamous-cell carcinomas of high-grado malignancy, should be excised widely with the scalpel.

Traenkle considers surgical excision and plastic repair the method of choice for scalp lesions of large size. In general, he favors excision and grafting for lesions involving large areas.

The tendency of many basal-cell epitheliomas to penetrate deeply and spread out under the normal skin, producing the so-called "silent extension," or "iceberg" type, is not sufficiently appreciated by many therapists. This is especially true of basal-cell epitheliomas about the angle of the nose and in the inner canthi. There is frequently a great difference between the actual extent of the lesion and the visible ulceration, or even the induration felt. In treating these lesions a wide margin must be allowed.

Michelson, H. E.: Cutaneous Cancer. *J. A. M. A., 136:* 683, Mar. 6, 1948.

Michelson stresses the need for looking on every localized cutaneous growth, regardless of its size or duration, as a potential cancer and of not being satisfied until an accurate microscopic diagnosis has been secured. Performance of a biopsy on every such growth is imperative. One should not be misled by a small stationary growth, but always investigate it as thoroughly as a more destructive one.

Lesions which grow upward, that is, rise above the skin surface, as a rule are easier to manage than those whose direction of growth is either lateral, downward or both. Lesions having a constricted base that tends to become pedunculated are usually more amenable to treatment. So-called recurrences may often be the result of growth extensions that were present but had not been suspected and hence were not treated. One of the crying needs for successful treatment of cutaneous cancer is a means for visualizing and outlining the entire growth.

According to Michelson, all fixed keratoses should be considered precancerous, although a statistical study reveals that the so-called senile keratosis is much more important than seborrheic keratosis. Complete removal of both types is the only safe procedure. Areas harboring chronic inflammation, such as plaques of lupus vulgaris, discoid lupus erythematosus, chronic roentgen dermatitis and even stasis ulcers, may be broadly considered precancerous. *Change in the type of inflammation or in* the morphology of these diseases calls for microscopic study.

A Wassermann test should be done in the presence of every ulcer or tumor. Even the most careful examination does not reveal the true character of a growth. An inflammatory halo, elevation, scaling or induration usually means that the border of the lesion is beyond the visible or palpable outline. An excision must be made from the most active border, large enough and deep enough to give the pathologist a representative section.

It is incorrect to state that surgery or irradiation or some other method is the method of choice for treating cancers of the skin. Every case should be considered individually. Therapists should know the limitation of their particular method, and combined methods should be used when indicated. The clinical diagnosis of cutaneous cancer is a matter of sensible suspicion. The positive diagnosis rests on the excision of tissue for microscopic study.

Editorial Comment: If the advice that one should always investigate a small stationary cutaneous growth by biopsy were carried out literally, a biopsy would have to be done on every nevus and papilloma.

MISCELLANIES

Dufresne, O.: Treatment of Angiomata. *Canad. M. A. J., 58:* 139, Feb. 1948.

Angiomas are divided by Dufresne into

port-wine stains, strawberry marks, cavernous types, stellar angiomas, and lymph angiomas.

He states that for port-wine stains the results of treatment are limited, although, in his experience, ultraviolet radiation in repeated blistering doses and carbon dioxide snow with slight pressure are the best therapeutic methods.

For strawberry marks, he recommends as the best therapy contact roentgenotherapy in doses varying from 250-r to 400-r, repeated at about 4 to 8 weeks. Usually after three to four treatments the strawberry mark disappears.

For cavernous angioma, interstitial radium therapy is recommended as the treatment of choice. The needles or removable platinum or gold implants are inserted obliquely into the angioma through healthy skin beyond the edge of the lesion. The dose is below the amount which produces a skin reaction, and treatment should not be repeated while any improvement is occurring or while there are still reactive changes in the lesion or in the surrounding skin. Generally the intervals between treatments are 6 to 8 weeks. For superficial cavernous angiomas of difficult access (nostrils, eyelids, oral canals, *et cetera*) and for those of medium size involving the superficial skin, external radiant treatment at a distance is preferred.

For stellar angiomas, electrolysis is recommended. A fine needle is inserted into the lumen of the affected vessels. This is connected with the negative pole of the galvanic current. A small amount of current (a few m. amp. for 1 or 2 minutes) is used to avoid dangerous scarring.

Lymph angiomas require diathermocoagulation combined with roentgenotherapy as the treatment of choice.

Marin, A.: Rhinophyma and Its Treatment. *Canad. M. A. J., 58:* 69, Jan. 1948.

Experiences with the treatment of nine patients with rhinophyma are recorded by Marin. These were all men. The histopathologic changes consist mostly of a marked hypertrophy of the sebaceous glands and of the fibrous connective tissue accompanied by a vascular dilatation. In about 10 to 15 years, the nose obtains a permanent size showing almost no tendency to enlarge.

The author prefers treatment by cutting down the size of the nose with a scalpel or sharp pointed scissors, hemostasis being obtained by electrocoagulation and by compression. Excision is conservative and care must be taken to excise moderately at the alae or at the tip of the nose.

If excision has been conservative, a normal appearing epidermis regenerates. Marin also thinks it advisable to give a few preventive treatments of superficial filtered roentgen-rays to the nose following operation for postoperative lesions of folliculitis and hyperemia.

FURTHER CONSIDERATION OF THE SURGICAL MANAGEMENT OF CHRONIC VARICOSE ULCERS

NEAL OWENS, M D AND HARDEE BETHEA, M D

New Orleans, La

INTRODUCTION AND HISTORY

Early historical records reveal that varicose ulcers were a source of great concern to patients as well as a perplexing problem to the physicians concerned with their treatment Undoubtedly Job had associated with the recorded pain which he suffered from his numerous boils, considerable added discomfort as the result of associated chronic leg ulcers History records a great variety of treatments that have been applied to chronic leg ulcers of the lower extremities, which numerically would equal the array of physicians who recommended their applications Among the earlier physicians recommending treatment for this condition there was a belief that satisfactory treatment required the application of a brew possessing the power of drawing from the local ulcers all noxious properties which served to produce them Strangely enough this same fallacy seems to have prevailed through the ages, since practically all recommended treatments were designed with the same thought It was not until the importance of a coexisting varicose vein in the production of leg ulcers was fully understood that a rational form of treatment was advocated Since then a variety of treatments have been suggested, which incorporate the fundamentals necessary for the correction of these chronic ulcers, while others appear to be without physiologic background A critical analysis of some of these will be made subsequently, in an attempt to rationalize the treatment of these conditions by means of radical surgical extirpation

INCIDENCE

Chronic varicose ulcers of the lower extremity are more common than any other type, representing about 90% of all chronic ulcers of the leg (Thomas) Heredity is important in about 65% of all cases of patients suffering from varicose veins or chronic ulcers (DeTakats, Curtis) Varicose ulcers most frequently occupy the area above the medial malleolus and are seen more commonly on the left leg than on the right In an analysis of a small series of 64 cases of chronic ulceration involving the lower legs, Goodman found 26 patients presented chronic ulceration involving the left leg, whereas 25 patients showed involvement of the right, 13 patients were found with involvement of both legs A high percentage of patients with ulcers involving only the right leg revealed defects which are clinically of the luetic type, 13 patients of the latter group showing positive Wassermann reactions In the group of patients representing ulcers occupying only the left leg it was not possible to make a clinical diagnosis of syphilis Likewise in the group of patients showing ulcers involving both legs, a clinical diag

nosis of syphilis could not be made. In patients showing ulcers involving the right leg only, 40% revealed a negative Wassermann reaction, whereas in the group showing involvement of the left leg 73% revealed negative Wassermann reactions. A small percentage of chronic ulcers of the lower extremity will be found to arise as the result of sickle cell anemia. This latter condition, as well as syphilis, should be ruled out before a positive diagnosis of chronic varicose ulcer is presumed to be established.

PATHOLOGY

Chronic varicose ulcers of the lower extremities are usually found involving the lower medial aspect of the leg in association with a tremendous amount of surrounding and underlying scar. These ulcers vary in size from a small discrete defect, a few millimeters in diameter, to extensive ulcers which completely encircle the leg and which may be as much as six inches in width. A typical chronic varicose ulcer is seen as a relatively discrete area of ulceration with sloping or ill defined margins. One seldom sees the sharp, well defined margins that are so often seen in the luetic ulcer. The base of the ulcer is, as a rule, seen as a dirty, grayish mass of edematous granulation, the color and edema being modified by the amount of infection, associated trauma and chronicity. Surrounding the actual ulcer itself, one sees a darkened, discolored skin, associated with extensive induration, dryness, scaliness and eczema. The discoloration of the skin is the result of deposits from broken down red blood cells. On palpation, the surface of the skin feels hard and fixed, denoting extensive invasion of scar which grequently extends down to become attached to the bone or the periosteum covering the bone. There is no evidence of any normal subcutaneous tissue. Because of disturbance to or complete loss of the normal sebaceous and sweat glands in the region, the skin reveals an abnormal dryness and scaliness which is typical. Further palpation reveals here and there small venous lakes, outlined as soft areas lying between firm ridges of scar, which can be traced through their tortuous course by the firm walls which mark their boundaries. The skin is almost invariably hard and firmly attached to the deep structures. As a result of this fixation and lack of resilience one frequently finds the foot and ankle held in abnormal positions. There is a varying amount of local edema. Various authors have conclusively shown a decrease in the amount of blood supply as well as a definite obstruction to the local lymphatic drainage (DeTakats, Trout, Mason). It is because of disturbance in the local blood supply and blockage in the normal lymph drainage that much of the chronic edema develops. Heredity plays a prominent role in the development of varicosities and chronic varicose ulcers of the lower extremities. Patients who have a predisposition frequently show varicosities of the septal mucosa, small cutaneous nevi and spiderlike telangiectasia, in association with vascular fragility which is so marked that numerous ecchymoses develop from the slightest injury. These same patients may show no abnormality in bleeding time, platelet count or coagulation time. Varicose ulcers are unquestionably the result of a combination of changes that develop in the region of the ulcer. Perhaps the first factor in the development of a chronic

leg ulcer is that of venous stasis. Associated with this is a progressive anoxemia and local acidosis which develops as the result of stagnation of the metabolic processes in the skin and subcutaneous tissue. An analysis of the contents of this accumulated stagnant residue shows a collection of catabolites with a tremendous concentration of metabolites; there is an increase in the CO_2 content along with a corresponding decrease in the O_2 content; a decided increase in the NPN content, along with a local acidosis; a decrease in arterial supply and a progressively developing edema. One can see how slight trauma to tissues showing the above alterations would serve as a mode of entrance to bacteria which would invade the tissues to produce an early ulceration, and act as a focus for the development of a chronic leg ulcer, unless early adequate treatment was instituted. Following the entrance of bacteria into such an area of low resistance, the logical sequel would be the development of an erysipelas, a lymphangitis or a lymphangitis with an associated phlebitis. Any of these conditions would produce a disturbance in lymph drainage with a resulting increase in edema. These complications would enhance logically the development of an ulcer. Due to the lowered resistance of the local tissue, infection would be difficult to combat. Progressive infection would mean further interference with lymph drainage, subsequent proliferation of scar and diminution of local blood supply. These factors would quickly develop into a vicious cycle which would progress through the stages of circulatory interference, lymph stasis, massive scar formation and chronic ulceration.

COMPLICATIONS

When one considers the tremendous pathology associated with chronic varicose ulcers of the lower extremities, along with numerous physiologic alterations in the local areas, obvious complications would be: erysipelas, lymphangitis, phlebitis, osteomyelitis, abnormal fixation of the foot due to deep scar attachment and callous formation with subsequent development of trophic ulcers. Erysipelas is not uncommonly seen as a complication resulting from the mildest sort of trauma, frequently the result of bacterial invasion through a break in the skin resulting from scratching. This is a most troublesome complication and not infrequently initiates changes which predispose to sufficient disturbance in lymph circulation, scar proliferation and diminution of blood supply to cause the development of chronic ulcers at a later date. Lymphangitis is a normal sequel to erysipelas and as a result of this we commonly find obliteration of sufficient lymphatics to produce a tremendous local edema. If the virulence of the invasive organisms is sufficient, phlebitis may come as a secondary complication to erysipelas and lymphangitis. The disturbance here is proportionate to the extent of the involvement, the location and the type of thrombi which develop. It is not uncommon for this condition to precipitate a hazardous chain of events which may terminate in the ligation of some of the larger veins in order to avoid embolic phenominae. Associated with a chronic lymphangitis and phlebitis, one frequently sees a periostitis which may progress into an osteomyelitis. The virulence of the organism may become sufficiently attenuated in this area to permit

the development of an osteomyelitis with little or no symptoms, the condition existing unrecognized until diagnosed from a cursory x-ray study. There is considerable evidence that osteomyelitis developing as a complication of chronic varicose ulcer may be the result of a low grade infection transmitted through a nutrient vessel and not by direct invasion at the site of the ulcer. Many areas of osteomyelitis exist at sites remote from the ulcer as shown by x-ray, when a roentgenographic study of the bone at the site of the ulcer shows no evidence whatsoever of an osteomyelitic lesion. Ulcers of the lower extremities show an abnormal fixation of the foot due to an intense pull of the surrounding and uderlying scar. This may be in association with a simple fixation or an ankylosis of the immediate joint. Weight bearing at points which are abnormal will frequently produce callosities. If sufficient ischemia develops at the site of a callosity ulceration normally follows.

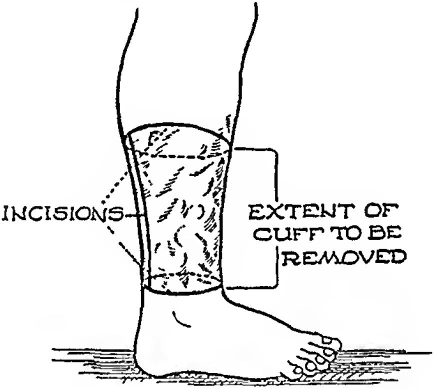
TREATMENT

Probably no surgical condition has been subjected to a greater variety of treatments than the chronic varicose ulcer of the lower extremity. During the initial, acute stage of the development of varicose ulcers, approximately 75% of these cases could be cured by relatively simple methods, if administered timely and properly. The administration of penicillin and the sulfa drugs, in association with venous ligation and injection, physiologic rest, elevation of the extremity for adequate drainage and the application of moist, saline pressure dressings should insure a satisfactory cure in the vast majority of these early cases. All of the above procedures have been adequately described by Ochsner, McPheeters, Dixon Wright and others. Since this paper deals only with the surgical treatment of the chronic varicose ulcer no attempt will be made to describe these in *further detail.*

In the light of associated pathologic and physiologic changes it is obvious then that a satisfactory cure will require that treatment be directed to chronic varicose ulcers complicated by varying amounts of infection, a marked diminution in the vascular supply, sufficient disturbance in the local lymph drainage to produce chronic lymph edema and a massive amount of scar. Obviously then that treatment must offer an adequate blood supply to the part and correct the disturbance in lymph drainage of the local area if the other pathologic states are to be improved. It is clear that far too much scar surrounds and underlies the local area in question to permit adequate circulation for the ulcer and surrounding tissue. It is equally obvious that the same factor causes gross disturbance in lymph drainage. Study of regional anatomy suggests that correction of these defects will entail complete excision of all offending scar, along with the complete excision of an equal area of deep fascia. This is necessary because the deep fascia completely invests the musculature of the lower leg, separating the blood supply into the superficial and deep circulation. Since the superficial circulation is shown to be inadequate it becomes necessary to connect with the deep circulation if one is to develop sufficient blood supply to support the graft necessary to correct the resulting defect following the excision of the scar. The same is true

regarding the reestablishment of the lymph circulation in order to diminish lymph blockage and correct the associated edema

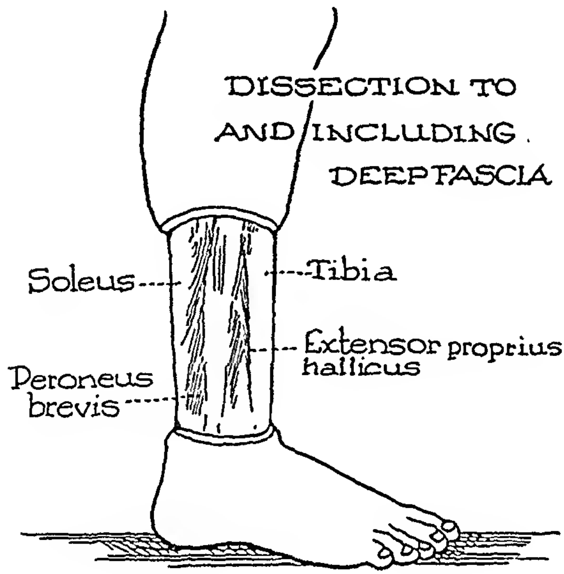
The senior author in 1937 advocated excision of not only the ulcer but also all the surrounding scar and discolored tissue It was emphasized that the dissection should include the deep fascia underlying the ulcerated area, thus establishing a connection for new blood supply and lymph channels which would develop a direct communication with the deep circulation and the associated deep lymphatics *(see Drawings I, II, III) At the time of the publication of the first* paper, it was advocated that a delay period of fourteen days should follow between the excision and the application of the graft It was presumed at that



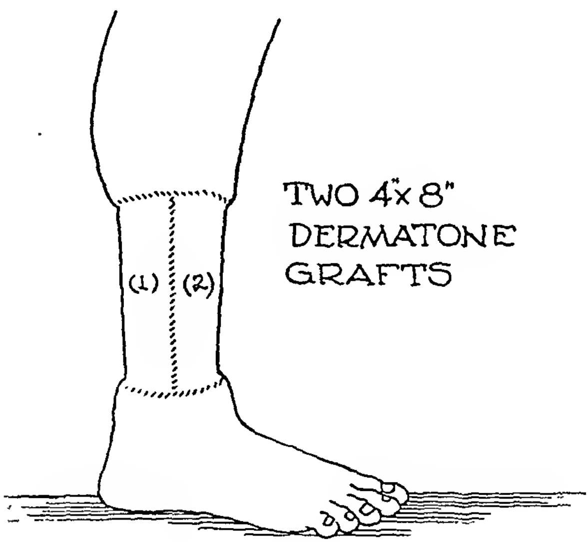
A

time that it was necessary to permit the development of adequate granulation tissue arising from the deep circulation to support these grafts It is the purpose of this paper to report a series of cases in which the delay period was dispensed with and in which grafts were applied immediately following excision of scar and deep fascia In all of the cases reported, the excision was carried out as previously recommended, including all scar and deep fascia, exposing muscle, tendon and bone beneath Half thickness grafts were immediately applied over the resulting defects (See Figures X, Y, Z) This technique has been followed since shortly after the publication of the first paper and has shown gratifying results In fact all grafts have shown a more satisfactory take with a resulting stability subsequent to the take than was formerly felt possible All grafts have remained entirely stable and there has been no disability due to adherence of the grafts to the muscles, tendons or bones Among the cases reported are men who have resumed work subsequent to operation and continued their normal occupations 1 road construction foreman, 2 boiler maker, 3 bar tender, 4 house-

wife; 5. itinerant who had no gainful occupation; 6. farmer. None of these patients are wearing any type of dressing and there have been no breakdowns in



B

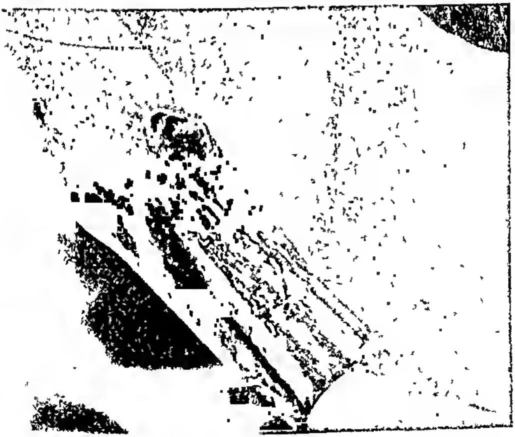


C

the grafts that have not been directly associated with trauma and which have not healed spontaneously.

Post-operative care of these patients has been a very important factor in the success of the procedure. After the application of the graft, a single layer of surgical rayon is applied over the graft, followed by the application of the usual

X



Y

type of pressure dressing held fixed by a #8 Ace bandage. Subsequent to this the foot is splinted in order to afford complete immobilization and lessen the motion of underlying muscle and tendon. The patient is kept in bed with the extremity either flat or slightly elevated for four or five days. At the end of the five day period the dressing is usually changed, and there is a reapplication of the splint. After the graft has become firmly attached and circulation insured, the patient is supervised in a series of vascular exercises. In the beginning the patient is permitted to allow his foot to hang over the side of the bed for

Z

approximately one minute. The time is increased daily as the condition of the capillaries permits until the patient is able to keep the foot in a dependent position for approximately thirty minutes without severe color changes. Subsequent to this he is permitted up and about on crutches and gradually increases the weight that is put upon his foot. Within two to three weeks the patient is, as a rule, able to walk with little discomfort or disability by the simple aid of a support which comes from a properly applied Ace bandage covering the extremity from the web of the toes to a point just beneath the patella. It must be emphasized that it is extremely important for the patient to wear this type of supportive bandage for a period of about six months subsequent to this opera-

tion Subsequent to this, the graft is entirely stable and the blood supply and the lymph circulation has been satisfactorily reestablished The patient, as a result of this operation, is able to resume his work or go back to his former job, after a period of approximately two months, where he should carry on with no interference This, of course, is in marked contrast to the type of healing which remains stable when the patient is essentially bed ridden and which does not permit him to resume usual activity

The following cases are reported

CASE #1

(See Case 1, Figures A, B, C, D)

W N , white, male, age 65, was admitted to the hospital on July 8 1940, with a history of ulcer of the left leg of twenty years duration Recent history of treatment with zinc peroxide and unna paste for four months On August 12, 1940, a high low venous ligation was done The first dressing was done on August 17, 1940, and it was noted that complete take of graft had been obtained He was discharged on September 27 1940, and there has been no evidence of breakdown or discomfort until 1942, when a traumatic ulcer developed as result of injury to leg from car fender Under treatment with pressure dressings this healed promptly In December, 1945, developed traumatic ulcer The patient received lumbar sympathectomy block with immediate healing which has remained stable until the present time

CASE #2

(See Case 2, Figures A, B, C)

Mrs C A , white, female, age 37, had good health until two months ago Then noticed ulceration on medial surface of left ankle The patient has had injection series for varicosities (the first four years ago and the last eight months ago) Varicosities followed a thrombophlebitis (18 years ago)

The patient was admitted to hospital on December 8, 1038 Excision and graft on December 15, 1938 Discharged January 8, 1939, with satisfactory healing No persistent breakdown

CASE #3

(See Case 3, Figures A, B, C)

G R , white, male, age 15, was admitted on April 15, 1939, with a 2½ year history of ulceration of the left leg It began when he accidentally scratched his leg against a nail protruding from a fence Various medications were tried and after one year and a half the ulcer finally healed Four months before admission the patient fell in his yard and tore open the old scar area On April 29, 1939, the whole affected area was excised and split skin grafts were immediately applied to the defect First dressing was on May 9, 1939, and complete take had occurred The patient was discharged twenty days later on May 29 1939 The patient is presently working as a bar tender and states that there has been no breakdown or any discomfort since the time of operation

CASE #4

(See Case 4, Figures A, B, C)

S P , white, male, age 42, was admitted to hospital on August 13, 1945, with the chief complaint of chronic varicose ulcer of left leg This had begun fourteen years ago In March, 1945, the patient had a series of six sympathetic blocks which resulted in a rapid healing of the ulcer In June of 1945 a high ligation and injection of the saphenus vein In August, 1945, a left lumbar sympathectomy was done This resulted in further im

a b

c d

CASE 1, FIGURE A. Photograph showing chronic varicose ulcer of twenty years duration.
CASE 1, FIGURES B, C, D. Photographs showing anterior, medial and lateral views of the skin graft which was applied to the defect resulting from radical excision of scar and underlying deep fascia. Photographs of grafts were taken eight years after their application to defect.

provement. On July 3, 1946, the entire ulcer and scarred area were excised and the defect immediately covered with split skin graft. He was dressed five days later and the note

a b

c

CA

CA

made "The graft has taken almost 100%" While in the hospital the patient developed a pneumonitis which delayed his discharge Finally was discharged through the clinic on

a b

c

Case 3, Figure A. Photograph of anterior aspect of left leg showing appearance of graft which was applied nine years ago for the correction of a defect resulting from the complete excision of a chronic leg ulcer with its associated scar and the underlying deep fascia.

Case 3, Figures B, C. Photographs showing medial and lateral aspects of the same leg.

August 3, 1946. The patient is presently working as a boiler maker and has no evidence of breakdown. There has been no breakdown of the graft areas.

CASE #6

(See Case 6, Figures A, B, C, D, E, F, G.)

E. G., white, female, age 38, had a Cesarean section in 1938. On November 20, 1940,

a b

c

Case 3, Figure A. Photograph of anterior aspect of left leg showing appearance of graft which was applied nine years ago for the correction of a defect resulting from the complete excision of a chronic leg ulcer with its associated scar and the underlying deep fascia.

Case 3, Figures B, C. Photographs showing medial and lateral aspects of the same leg.

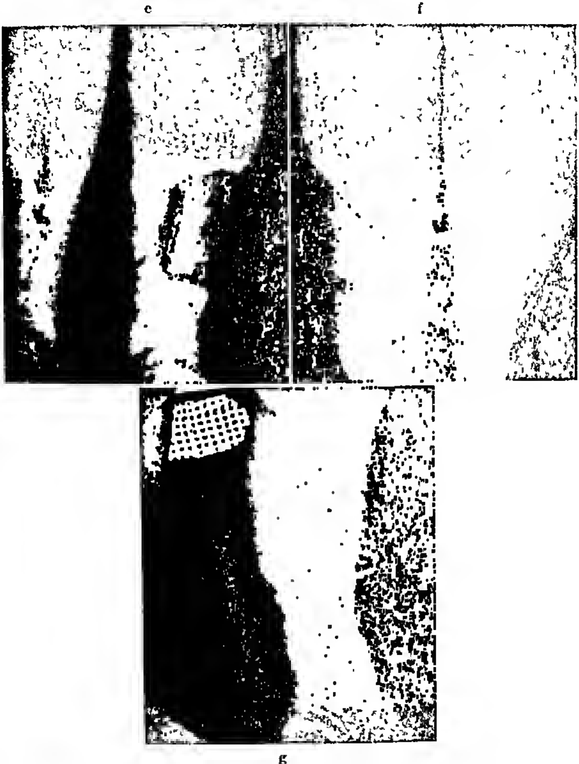
August 3, 1946. The patient is presently working as a boiler maker and has no evidence of breakdown. There has been no breakdown of the graft areas.

CASE #6

(See Case 6, Figures A, B, C, D, E, F, G.)

E. G., white, female, age 38, had a Cesarean section in 1938. On November 20, 1940,

applied. She was discharged on March 26, 1948, with the donor site and graft stable. At present there is no evidence of breakdown.



Case 6, Figures D, E, F, G. Photographs showing appearance of graft following radical excision of ulcer, scar and deep fascia.

CASE #7

(See Case 7, Figures A, B, C, D, E, F, G, H)

D. H., white, male, age 50, had a high and low saphenus injection in May, 1946. The patient was seen in consultation five months later and a diagnosis of chronic varicose ulcer of the right lower extremity was made. He was admitted to the hospital on October 17,

a b

c d

Case 7, Figures A, B, C, D. Photographs showing the extensive ulceration and scar associated with chronic varicose ulcer of twenty-seven months duration.

CASE 7, FIGURES E, F, G, H Photographs showing the status of graft, one and one half years later Note the extensive excision which was required

1946, for treatment of extensive infection prior to extirpation of ulcer and grafting He had a history of ulcer of the right lower leg, anterior surface, for 27 months He denies any precipitating trauma to this area He had various medications applied to this area without

improvement. On November 5, 1946, the involved area was excised and split skin grafts applied immediately to the defect. One area was left open because of the patient's un-

a b

c d

CASE 8, FIGURES A, B. C. D. Photographs showing extensive chronic varicose leg ulcer with surrounding scar. Duration about one and one half years.

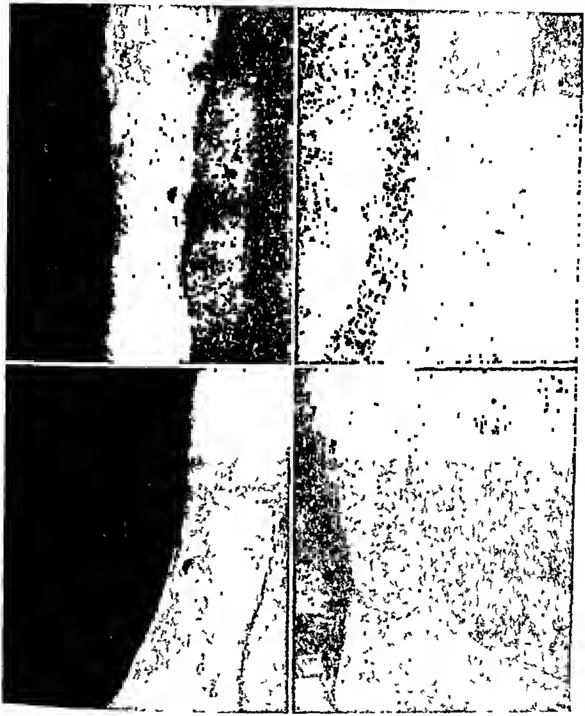
satisfactory reaction to anesthetic. This was later grafted in the dressing room on November 14, 1946. He was discharged as entirely healed on December 2, 1946, and has had no evidence of breakdown since. He is presently working as a farmer.

CASE #8

(See Case 8, Figures A, B, C, D, E, F, G, H.)

W. H., white, male, age 46, gave a history of having struck the anterior surface of the right leg in May, 1945, while trying to crawl from a barge to its pier. The wound failed to

e f



g h

Case 8, Figures E, F, G, H. Photographs showing condition of graft about one and one half years following its application.

heal. He had x-ray therapy on the ulcer from June until December 1945. At this time a graft was attempted but was unsuccessful. In February of 1946, the patient had a right lumbar sympathectomy. The ulcer began to improve for about four months and then

began to get worse. The patient was referred to us for treatment in the latter part of October, 1946, and a diagnosis of chronic varicose ulcer was made. The patient was admitted to a hospital and on November 1, 1946, the entire affected area was excised and immediately skin grafted. Healing was satisfactory except for two small areas (one over the anterior tibial tendon and the other on the medial border of the graft). The patient was finally discharged from the hospital on January 27, 1947, and has had stable healing since. He is able to walk and stand for several hours without discomfort.

The following patients were under the surgical management of the respective physicians listed:

E. G.	(Case 6)	Dr. Robert Wise
D. H.	(Case 7)	Dr. Robert J. Meade
W. H.	(Case 8)	Dr. Hardee Bethea

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RECONSTRUCTION OF THE AURICLE WITH DICED CARTILAGE GRAFTS IN A VITALLIUM EAR MOLD

LYNDON A PEER, M D

Newark, N J

In 1943 I reported a new method for reconstructing an auricle by inserting diced cartilage grafts in a perforated vitallium ear mold and burying the mold with its cartilage filler beneath the patient's abdominal skin (1)

Connective tissue and blood vessels grew through the openings in the mold and bound the separate cartilage segments together, thus forming a solid but somewhat elastic structure which was an exact duplication of the ear mold

This ear framework, formed with the patient's own rib cartilage and bound together by the patient's own connective tissue, was successfully transplanted beneath the skin in the ear region. The posterior surface of the cartilage and the raw scalp area were later covered with a split graft, and the distorted ear lobe sutured in the normal position

The auricle reconstructed in this manner was satisfactory in general outline and angle, but the finer detail present in the transplanted cartilage framework was obscured by the thickness of the overlying skin on the anterior surface of the auricle There was also a tendency to form fibrous tissue beneath the skin, and the cartilaginous framework became somewhat flattened as it healed against the rigid skull bone. My first patient had a very low hair-line on the side of the deformity, and some hair was therefore present on the upper part of the reconstructed auricle.

I have overcome some of these complications by the trimming operation illustrated in Plate V. This procedure tends to restore the sharp outline of the helix and crura, reestablish a deep concha and remove the hair-bearing skin which is present on the upper part of the reconstructed auricle

LATER EXPERIENCE WITH VITALLIUM EAR MOLDS

I have buried twenty-two additional vitallium ear molds since my first case report on this method in 1943.

One mold has been lost due to hematoma with later infection, and one diced cartilage framework became infected following transplantation in the ear region, resulting in partial loss of the cartilage Seven ears have been completely reconstructed and thirteen are in various stages of reconstruction.

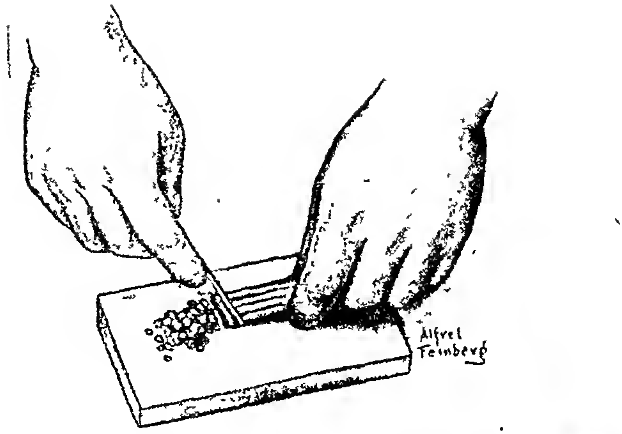
The technique described under the drawings in this paper constitutes my present management for the usual type of deformity. Variations in this technique are necessary to meet the requirements of individual patients

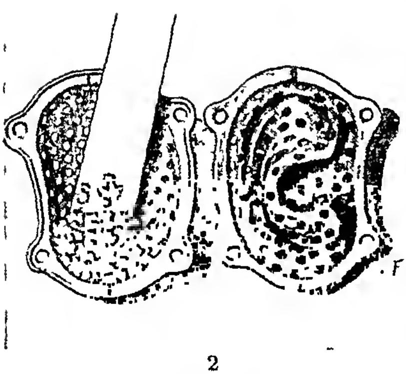
VARIATIONS IN TECHNIQUE

Occasionally one sees a congenital ear deformity with the entire upper portion of the auricle absent but with a very normal concha, ear lobe and ear canal.

PLATE I

1





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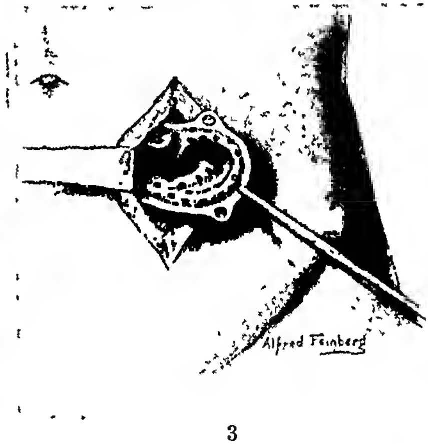


3

Formation of Ear Framework from Diced Cartilage Grafts Inserted in Vitallium Ear M

1. Rib cartilage removed from the right side of the patient's chest is diced into m small cartilage cubes

2. The "diced cartilage grafts" are introduced into each half of a perforated vitall ear mold.

3. The two halves of the ear mold have been fastened together with vitallium scr pressing the diced cartilage grafts into the shape of an ear.

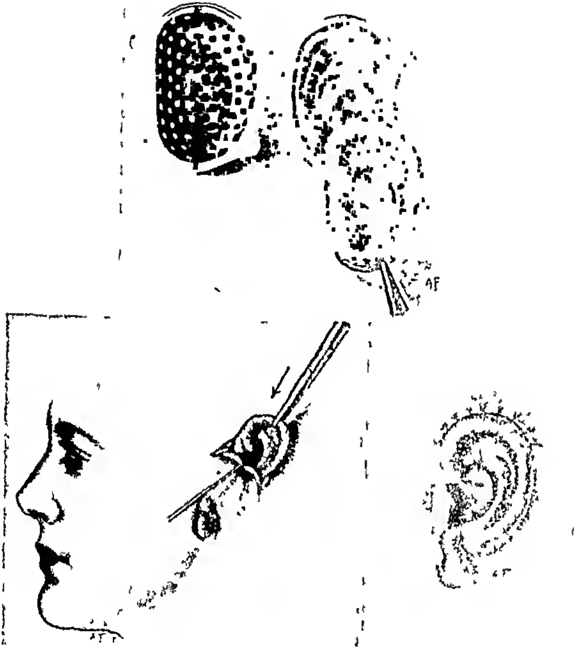
The mold containing the cartilage segments is inserted in a pocket beneath the patie abdominal skin. During a period of months, blood vessels and connective tissue g through the openings in the mold and fasten the separate cartilage cubes firmly togeth the form of an ear.

When both auricles are being reconstructed in a young child, diced cadaver cartila used to supplement the child's own cartilage so that there will be sufficient cartilage t both the right and left ear molds The operative procedures for the right and left ear carried out simultaneously. Thus, the total number of operations for reconstructing auricles are the same as for reconstructing a single auricle.

The vitallium ear molds are made by the Austenal Company of New York City. Med and large sized models are available to meet the general requirements of individual ca

PLATE II

1



2 3

Removal of Diced Cartilage Ear from Mold and Transplantation In Ear Region

1 The vitallium ear mold has been removed from the abdominal pocket 5 months following burial The two halves of the mold have been separated and the diced cartilage ear framewo[illegible]

2 [illegible]

the sk[illegible] ved pocket beneath

allow for subsequent sagging [illegible] the normal ear to

3 The wound ed[illegible]

cartilage [illegible]

is remov[illegible]

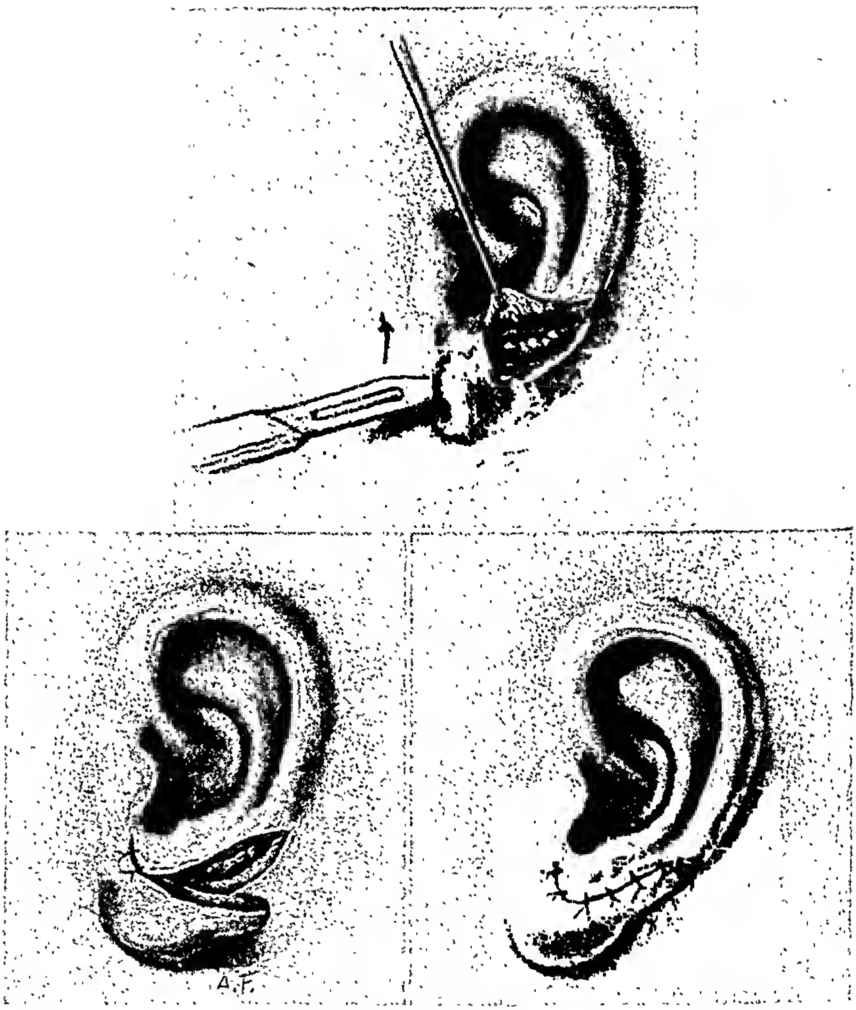
cartilage [illegible]

When a canal and ear drum are present or when the skin in the ear region has been severely scarred, it is advisable to [illegible]

neck skin just above the clavicle T[illegible]

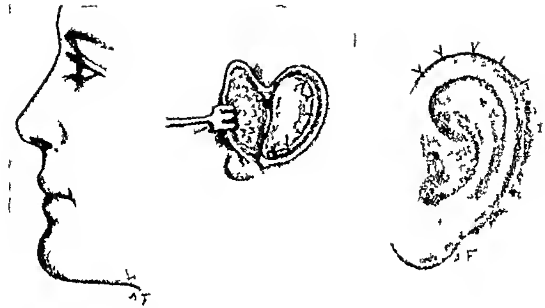
graft and the completed ear swung [illegible]

PLATE III



Adjustment of Ear Lobe into Normal Relationship with Reconstructed Auricle

PLATE IV



1 2

Grafting Posterior Surface of Auricle and Raw Scalp Surface with Split Skin Graft

1 Th...
teum o...
behind...
surface...

2 The auricle is sutured over the dental stent mold which is covered with split skin graft After about 7 days the dental stent is removed The split skin graft covers the raw scalp area and the posterior surface of the new auricle permitting the latter to stand out at an angle from the side of the head The degree of protrusion and height of the reconstructed auricle must be adjusted to conform with the normal ear on the opposite side of the head

The problem of repair is the same as for a traumatic amputation of the upper portion of the auricle, and the technique used is as follows: The cartilage along the upper margin of the auricle is exposed and buried under the skin, and during the same operation an ear mold filled with diced cartilage is inserted in an abdominal pocket. Five months later the cartilaginous framework is removed from the mold, and the upper part of the framework which corresponds to the ear defect is buried beneath the skin in the exact location of the defect. An Esser inlay is used to cover the back of the framework and the raw scalp surface. A variation of the trimming operation illustrated in Plate V restores the sharp outline of the helix and smooths out the junction point of the cartilaginous framework with the auricular cartilage.

When the ear canal and drum are present without the concha, or when the skin in the ear region has been severely scarred, it is advisable to transplant the cartilaginous framework beneath the neck skin just above the clavicle. The back surface of the cartilage is then covered with a split graft in the usual manner, and the completed ear swung up into position by means of a vertical neck tube. The neck tube method of transfer from the supraclavicular area is also useful when there are congenital fistulae in the skin surface of the ear region communicating with the pharynx. In such cases, however, the surgeon may prefer to remove the fistulae and later transplant the cartilaginous framework beneath the skin of the ear region.

PLATE V

Final Trimming Operation to Sharpen Helix, Increase Depth of Concha and Canal Region and Remove Hair Bearing Skin

(May be done in one or two stages depending on abundance of circulation in skin)

The contours of the reconstructed ear will not be as distinct as is indicated on this drawing due to the thickness of the covering skin, the formation of fibrous tissue beneath the skin and compression of the cartilage against the rigid skull bone.

1. An incision is made through the skin covering of the helix down to the diced cartilage framework of the ear. This incision should reduce the width of the helix by about ½. Most of the hair bearing skin will be located below this incision.

2. The skin is dissected from the underlying diced cartilage framework over the scapha and well down into the depth of the conchae.

3. An incision is made deeply into the cartilage and sufficient cartilage is removed to reduce the width of the helix and increase its prominence. It may be necessary to carry this incision down to the skin covering on the posterior surface of the auricle and remove a solid wedge of cartilage. This will allow the cartilage rim of the helix to roll downward producing a very normal affect.

Cartilage and fibrous tissue are widely removed in the region of the conchae leaving prominent ridges to accentuate the anterior and inferior crura. It may be necessary to remove all cartilage in the depth of the conchae.

4. The dissected flap of skin will be larger than is required to snugly cover the raw defect. This permits excision of hair bearing skin on the upper portion of the skin flap.

Mattress sutures are inserted through the posteriors surface of the auricle to draw the free margin of the skin flap into the cartilage groove or into actual contact with the deep surface of skin lining the back of the auricle.

5. Mattress sutures tied on posterier surface of auricle. The upper free margin of skin is not sutured because it tends to give a very natural appearance to the helix when allowed to heal without suture.

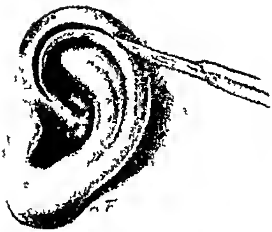
Additional prominence can be given to the tragus by rotating a cone of skin upward and backward.

It is wise to avoid the creation of minute detail in a reconstructed ear. When the ear looks right leave it alone.

Any remaining hair bearing skin is removed by the Ferris Smith principle of multiple excision or by electrolysis.

PLATE V

1



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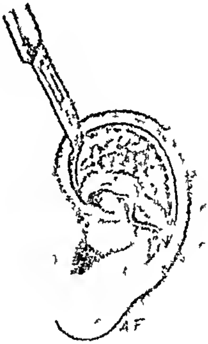


4

5

PLATE VI

1

2

3

1. Congenital bilateral deformity of both auricles with meatal atresia. The deformity of the right auricle was similar to that of the left auricle which is shown in the photograph.
2. Side view showing reconstructed auricle.
3. Front view showing contour and relationship of the right and left auricles both of which were constructed by the vitallium ear mold method.

PLATE VII

1

2

3

1 Congenital deformity of right auricle ...
2 The diced cartilage ...
clavicle The ...

... with the normal ear
face and muscle unbalance as-
... ear deformity.

PLATE VIII

1

2

3

1. Congenital absence of the upper portion of the auricle with relatively normal ear lobe, concha and ear canal. The drum membrane was present.

2. Post-operative results utilizing the upper part of a diced cartilage ear framework to supplement the patients own ear lobe and concha which form the lower portion of the ear. (See variation in technique)

3. Front view showing the relationship of the reconstructed ear with the normal ear.

PLATE IX

1. Congenital deformity of right ... [illegible]

with a split graft and the com-

thu ... [illegible]

Pla... ... could be used advantageously since the covering neck skin would provide a better color match.

I do not use the ear mold method in congenital deformities where the ear canal, concha and a reasonable portion of the helix are present. In these cases one can often detach the rim of the helix and transplant it at a higher level so that it is in good relationship with the upper portion of the normal ear on the opposite side of the head. The incision can be carried well forward into the concha if the latter is too small. The exposed edges of auricular cartilage are buried and the extent of the defect is outlined by the transplanted helix above, and the upper part of the ear lobe below. About two months later finely diced rib-cartilage (2) is packed beneath the skin in the area of the defect, and at a later date the back surface of the cartilage is grafted. The trimming operation illustrated in Plate V may be used to shape the diced cartilage segment so that it conforms with the cartilage of the helix and concha. The principle of splitting the auricle and transplanting the upper pole in normal relationship with the opposite ear has been well illustrated by Jerome Webster (3) in our Society Transactions of 1944. There are many useful variations of this principle.

Dr. Ferris Smith (4) suggested that it might be feasible to graft the anterior surface of the diced cartilage framework with a thin split graft, which would have less tendency to obscure the elevations and depressions of the auricle. I utilized this suggestion in one case, but my graft was only a partial take and later contracture distored the shape of the cartilage framework. This method appears to have possibilities, since we do successfully graft the back surface of the cartilaginous framework without causing undue contracture.

Dr. Gustave Aufricht (5) reported a case in which he used a perforated ear mold of acrylic resin to form the cartilaginous framework and applied a shifted flap of skin in the ear region to provide a lax covering. This is an interesting variation of the technique which may be helpful in certain cases.

When the two auricles are being reconstructed in a young child, diced cadaver cartilage is used to supplement the patient's own cartilage, thus providing sufficient cartilage to fill both ear molds. The cadaver cartilage is placed in the back portion of each mold so that later possible absorption of this dead foreign cartilage will not destroy the anterior ear structure.

The operative procedures for the right and left ear are carried out simultaneously. Thus the total number of operations for reconstructing two auricles is the same as for reconstructing a single auricle.

AGE AT OPERATION

Whenever possible the first operative step to reconstruct an auricle should begin when the child is about four years old. This allows the surgeon a sufficient time interval in which to complete the ear before the child enters school, which lessens his handicap and facilitates adjustment with schoolmates.

Children at four years of age have relatively large ears in proportion to their height and the size of their heads. Actual measurement will usually demonstrate that the normal ear is only slightly smaller than the corresponding ear of the father or mother.

From the medium and large sized vitallium ear molds available a model is

selected which is slightly larger than the child's normal ear. Any small amount of difference in size can easily be adjusted by reducing the larger ear when the child has attained his growth.

THE HEARING

The internal ear develops earlier and separately from the middle and external ear, which develop together. Congenital anomalies of the external ear are therefore often associated with deformities of the middle ear. The internal ear, however, is usually normal in these cases, so that patients with absence or deformity of the auricle associated with meatal atresia have a normal bone conduction on the side of the deformity.

Children with bilateral meatal atresia will hear (through bone conduction) a voice raised slightly above normal and will learn to speak rather late in a somewhat toneless voice. We have found that the quality of speech in these bilateral cases is greatly improved if the children can be induced to use a hearing aid.

A normal drum membrane is never present in patients with meatal atresia, and operations to provide skin-lined tubes in the canal region in the hope of exposing a normal drum membrane are useless procedures.

We have operated on two patients through the mastoid, providing a skin-lined opening into the antral cavity. The hearing was not materially improved in either of these children. This same procedure combined with a Lempert operation might improve the hearing in selected cases.

Children with congenital meatal atresia on one side and a normal drum membrane on the opposite side will hear well and consequently learn to speak in a normal manner.

TYPE OF CARTILAGE USED

Autogenous cartilage is always the material of choice for transplantation. It survives as living tissue, is not subject to invasion or absorption, and like an autogenous skin graft it remains until the individual in whom it is transplanted dies. This is true whether the cartilage is transplanted with or without its perichondrium.

Experimental studies on humans have demonstrated that autogenous rib-cartilage grafts retain their normal structure up until twenty-five years following transplantation, and that the cells in these grafts remain as living cartilage cells (6).

Preserved cadaver grafts are invaded by fibrous tissue usually over long periods of time (7), but occasionally they are absorbed rather suddenly. Preserved cadaver cartilage is therefore not good grafting material to support an ear in a young child with a possible sixty-year life expectancy.

GROWTH OF AUTOGENOUS CARTILAGE GRAFTS

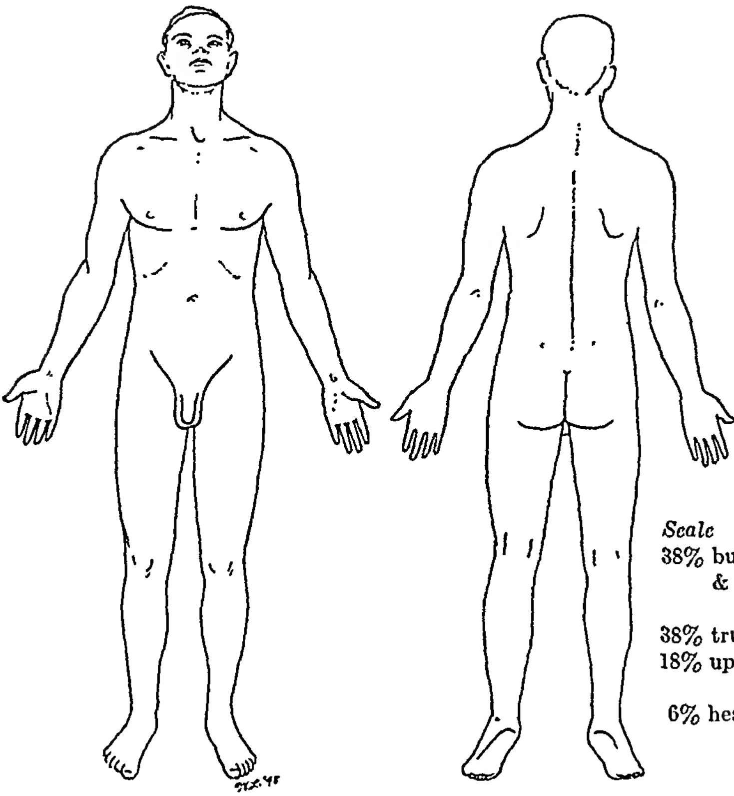
Dupertuis (8) demonstrated the growth of costal cartilage grafts in rabbits, and my own experimental studies (9) with young human costal cartilage grafts indicated that there was a small increase in the size of the graft in most cases.

Division of Plastic Surgery——Kings County Hospital

BURN CHART....DIVISION OF PLASTIC SURGERY

NAME.. Age......... Color..........

Anterior *Posterior*



Scale
38% buttocks foot 1/6
& l. exts. leg 2/6
thigh 3/6
38% trunk and neck
18% upper exts. hand 1/4
arm 3/4
6% head

1a

TYPE: a. Recent.... Old........ Previous Treatment..................................

b. Clean..... Infected.... Pot. Infected..................................

Percentage: 1°.................... 2°.................... 3° ....

JOINTS & SPECIAL AREAS INVOLVED: Elbow.................. Fingers.................. Axilla.................. Neck.................. Knee.................. Other..................

End Result: Died.................. Healed.................. Scarred.................. Contracture.................. Cosmetic.................. Functional.................. Other..................

Cause: ....

Prognosis: .... Operations: Yes.....

Complications: .... No .....

Fig. 1. Charts Used to Record Burns at Kings County Hospital

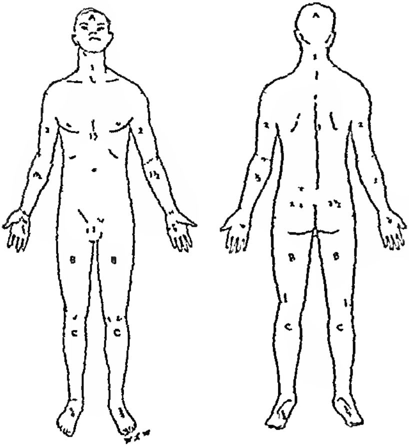
a. Berkow's diagram. Coakley's modification.
b. Lund and Browder's diagram for adults.
c. Lund and Browder's diagram for children.

BURN CHART DIVISION OF PLASTIC SURGERY

NAME AGE COLOR

Anterior *Posterior*

1°
2°
3°



1B

Scale
38% buttocks foot 1/6
& l ext leg 2/6
thigh 3/6
38% trunk and neck
18% upper exts hand 1/4
arm 3/4
6% head

TYPE a Recent Old Previous treatment
b Clean Infected Pct infected

Percentage 1° 2° 3°

JOINTS & SPECIAL AREAS INVOLVED
Elbow
Fingers
Axilla
Neck
Knee
Other

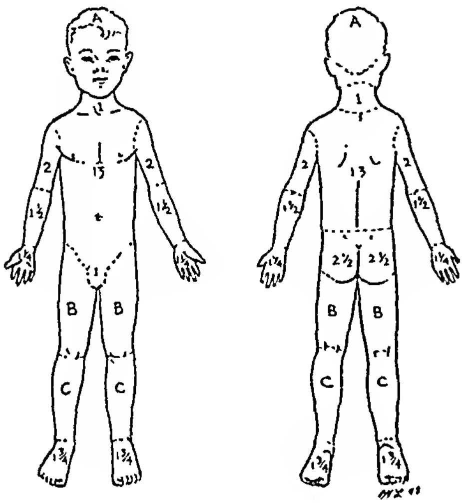
End Results
Died
Healed
Scarred
Contracture
Cosmetic
Functional
Other

Cause
Prognosis
Complications

Operations Yes
No

BURN CHART....DIVISION OF PLASTIC SURGERY

NAME . . . . AGE. . . . . .NUMBER. . . . .
BURN RECORD. AGES: Birth – 7½. DATE OF OBSERVATION. . . . .



Scale
38% buttocks foot 1/6
& l. exts. leg 2/6
thigh 3/6
38% trunk and neck
18% upper exts. hand 1/4
arm 3/4
6% head

1e

RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

AREA	AGE		
	0	1	5
A 1/2 of Head	9½	8½	6½
B 1/2 of One Thigh	2¾	3¼	4
C 1/2 of One Leg	2½	2½	2¾

% BURN BY AREAS

Probable 3rd° Burn { Head. . . . . .Neck. . . . . Body. . Up. Arm. . .Forearm. . . .Hands. . .
Genitals. . . .Buttocks. . Thighs. Legs. . . . . .Feet. . . . .
Total Burn { Head. . . . . . Neck. . . . . Body. . Up. Arm. . .Forearm. . . .Hands. . .
Genitals. . . .Buttocks. . .Thighs. . . .Legs. . . . . .Feet. . . . .
SUM OF ALL AREAS: Probably 3rd° . . . . Total Burn. . . . .
TYPE: a. Recent Old . . Prev. Treatment . . . .
b. Clean . Infected Pet. Infected . . . .
Percentage: 1° . . . 2° . . . . 3°. . . . .
JOINTS & SPECIAL AREAS INVOLVED: Elbow . Fingers . . Axilla . . . Neck . . Knee Other .
End Result: Died. . . . .
Healed. . . . .
Scarred. . . . .
Contracture. . . . .
Cosmetic. . . . .
Functional. . . . .
Other. . . . .

Cause: . . . .
Prognosis: . . . . Operations: Yes. . . . . .
Complications: . . . . No. . . . . . .

The estimation of the proportion of skin area which has been burned is an important guide to both prognosis and therapy. Berkow's table has been used very widely for this purpose and is a convenient and simple standard. Lund and Browder searched for more accurate standards and diagrams to allow for variations in proportions at different ages. Their studies showed that the face area is larger, proportionately, in infants than in adults, whereas in infants the area of thighs and legs is proportionately smaller than those areas in adults. The proportion of skin of all other parts is essentially unchanged from one age to another. Lund and Browder assigned a smaller area to the trunk than did Berkow. Although Lund and Browder's charts are accurate, Berkow's method is somewhat simpler to use and the burned area is more graphically outlined on Berkow's chart. For clinical purposes, either standard is perfectly adequate as a guide to prognosis and therapy. The area of a burn is nearly always greater than that estimated by inspection on admission to the hospital.

PATHOLOGY

Local pathology varies with the depth of the burn. In mild, first degree burns, there is some dilatation of capillaries, arterioles and venules with an increase in blood flow. In more severe burns, there is capillary wall damage with a leakage of plasma into the tissue spaces. At the surface, this is manifested by blister formation and exudation from broken blisters. At a deeper level, the increase in capillary permeability is marked by edema and increased lymph flow from the area.

The processes of repair begin soon after the burn occurs. In mild burns this consists of a return to normal of blood vessels and absorption of the fluid in the tissue spaces. In more severe burns where cells have been killed, the dead cells are removed by lysis and phagocytosis at the junction between living and dead cells. This results in the formation of a slough of dead tissues at the surface. This slough remains attached until the collagen fibers which connect it to living tissue, are digested. Epithelization occurs from skin edges, remnants of hair follicles and deep glands, or if the burn is severe enough, from the skin edges alone. If the dermis has been destroyed and repair occurs by ingrowth from the edges, the result may be quite imperfect, because only a thin sheet of epithelium will cover the scar tissue. This scar epithelium is poorly nourished and poorly attached at its base and is subject to breakdown and damage on slight trauma.

Changes in the formed elements of the blood are sometimes seen in severe burns. Hemoglobinemin may be seen in deep burns of more than 10% of the body area and hemoglobinuria in deep burns of 30% area. These conditions result from intra vascular hemolysis due to the heat of the burns and disappear in 24 to 72 hours. There may be a thrombocytopenia in very severe burns for several days following injury. Leucocytosis is seen early and is usually directly proportional to the severity of the burn. Rarely, severe burns show a leucopenia from the first to the sixth day.

Kidney damage is an important complication in the early course of patients

with severe burns. Albumin, hemoglobin, and casts may be found in the urine. In more severe cases there may be oliguria, azotemia and elevation of the blood N.P.N. The origin of the hemoglobinemia has already been mentioned. The other changes are of the type seen in shock caused by any other mechanism and are probably due to decreased blood flow through the kidney. Intravascular hemolysis and hemoglobinemia may be a contributing factor in causing injury to the kidneys, and the histological picture of the kidneys in severe burns sometimes suggests this possibility. These changes are characterized by the presence of hemoglobin casts, epithelial casts and necrosis of tubules.

Liver necrosis in burns has been reported by many workers but few cases have been reported where bland ointments, saline solution, or dry dressings have been used. Many competent observers feel that liver damage can be attributed to tannic acid poisoning but there is a case of liver necrosis following triple dye therapy, and this service has seen a case of liver necrosis following treatment with sulfadiazine-triethanolamine spray.

In 1842, Curling called attention to the occurrence of intestinal tract ulceration following burns. This lesion is most apt to result in a severe, septic, third degree burn and is usually manifested by epigastric pain, melena and hematemesis. Stomach, duodenum, or both may be involved and hemorrhage is twice as apt to cause death as perforation. The condition is usually but not always fatal. The etiology is obscure and the complication is rarely seen under modern modes of therapy.

Respiratory tract damage due to smoke inhalation may be seen in burn cases. The resultant lesion is essentially a laryngotracheo-bronchitis which may go on to mucosal necrosis, pulmonary edema and pneumonia.

Various authors since 1917 have reported pathological changes in the adrenal glands of burn cases. These changes include swelling, redness, edema, hemorrhage, and cortical necrosis. Recent reports have suggested that in burns, the adrenal glands are stimulated to exhaustion by the adrenotropic hormone of the anterior pituitary gland. There have been reports, too, of the pathology in spleen, lymph nodes, heart and central nervous system, but the nature of these changes and their significance is obscure.

Marked changes in nitrogen metabolism of the burned patient have been noted by a number of workers at various hospitals. Severe burns show a high output of nitrogen in the urine during the first three weeks and sometimes for as long as several months. The resulting negative balance may reach the magnitude of 25 to 30 grams of nitrogen per day. The causative mechanism is not yet known but a similar change has been demonstrated in fractures and other types of trauma. In addition to the above described urinary nitrogen loss, there may be a nitrogen loss of comparable magnitude from the surface of the burn and this latter may continue over long periods of time in extensive deep burns. The marked nitrogen losses from these two sources may result in the occurrence in the burned patient of severe hypoproteinemia within a few weeks' time, unless proper therapy is instituted. A continuing hypoproteinemia may cause tissue protein loss with weight loss, edema, weakness and death from malnutrition as the end results.

a b

c d

Fig. 2. Extensive Third Degree Burn in an Eight Year Old Girl

a. Lateral view of burn ready for grafting.
b. Anterior view of burn ready for grafting.
c. Lateral view after grafting.
d. Anterior view after grafting. Donor sites are visible on the abdomen.

a

b

c

FIG. 3. EXTENSIVE, DEEP BURNS IN A 35 YEAR OLD NEGRO

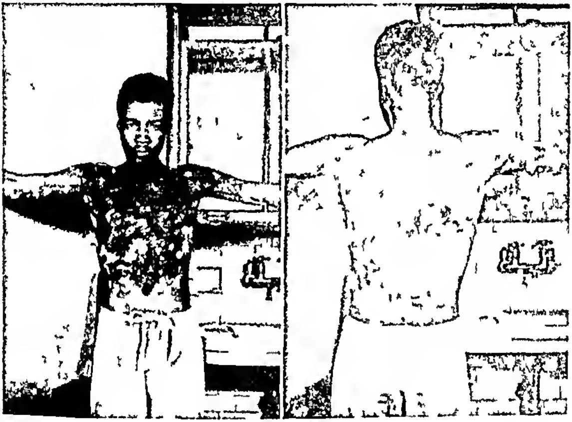
Face, neck, arms and Anterior Chest Required Grafting. At the time of the first operation, the patient's temperature was 106 degrees F. and ribs, intercostal muscles and a small area of pericardium were exposed.

a. Burns ready for grafting
b. Burns ready for grafting
c. Neck and chest covered by split skin grafts. Abdominal donor sites can be seen.
d. Burned area completely covered by grafts. Shoulder function and cervical range of motion remain good.
e. Healed donor sites on back. Another view which demonstrates the good range of shoulder motion.

Sodium chloride may be lost into the burned area as evidenced by a decrease in the plasma chloride and sodium concentration and a rise in the plasma potassium concentration Hyperglycemia and acidosis are sometimes observed, and many workers have noted an apparent depletion in Vitamin Metabolism

SHOCK

Shock can be expected in burns which involve more than 15% of the surface area of healthy adults and more than 10% of the surface of children or aged persons The most important factor in the causation of burn shock is the loss of plasma from the circulation into the tissues of the burned area Richards and his associates demonstrated this mechanism in shock resulting from burns and



d e

FIG 3

from peritonitis They found a consistent hemo concentration, decrease in cardiac output and right auricular pressure with corresponding decrease in blood volume and fall in blood pressure Because of the increased blood concentration and increased peripheral resistance in burn shock, blood pressure values tend to remain close to normal in spite of markedly reduced total blood volume Because of this, blood pressure is a poor index of the severity of the shock process in burns Many investigators have tried to demonstrate the role of toxic substances released from burned areas in the production of shock There may be many substances released from a burn area which can depress the circulatory system but there is no evidence that these toxins are important in causing burn shock in man The entire picture can be accounted for by the loss of plasma into the burned area and a consequent loss of effective circulating blood volume

The Crile theory of nociceptive stimuli causing shock has little support in recent studies and sedatives have a negligible therapeutic effect on burn shock.

It has been pointed out that blood pressure readings are a poor indication of shock in burns. More sensitive and practical criteria for therapy can be found in hematocrit, hemoglobin and serum plasma protein determinations. It has also been said that if the urine output is good, the general circulation is good.

After severe shock has persisted in an individual for a long period (4 to 5 hours), it becomes irreversible. The exact mechanism in this change is a controversial point. Nevertheless, it is universally recognized that prolonged shock eventally produces a condition where restoration of blood volume will no longer restore an adequate circulation for life.

TREATMENT

The treatment of burns is constantly changing. The regime presented here is that which has evolved from an evaluation of the results of other clinics and the experiences of the Plastic Surgery Service of Kings County Hospital in the treatment of more than fifteen hundred burns, all severe enough to require hospitalization.

Upon admission to the hospital, the patient has his burned areas covered with a sterile sheet or sterile towels. If the patient is conscious and in pain, morphine or codeine may be used to allay it. If shock is a factor, Morphine is given intravenously to insure immediate absorption. A diagram is then made of the burned area on a Burn Chart. An attempt is made to estimate, as far as possible, both the degree and depth of the injury since such an estimate is necessary both for the prognosis and as a guide to therapy.

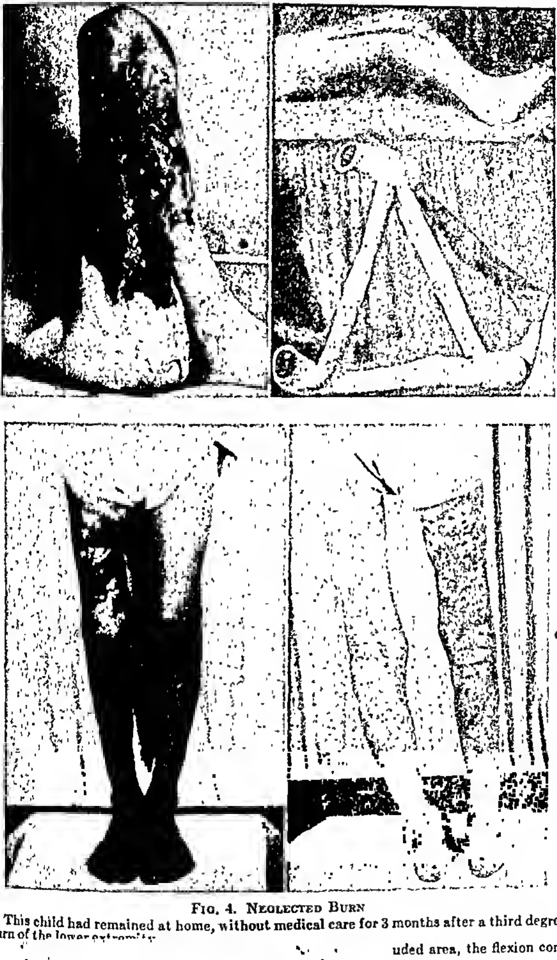
If shock is present or if shock is anticipated from the extent of the burn, intravenous therapy is started. Normal saline or 5% glucose in normal saline is used and plasma may be administered simultaneously or given after the electrolyte infusion has been given, depending upon the requirements of the case. The fluid that is lost from burns is similar in composition to blood plasma so it is logical to replace this fluid loss with plasma. However, there is experimental evidence that sodium ions administered as isotonic sodium chloride are of some value in preventing shock in burn cases. Elman has recently emphasized the fact that if the patient is not vomiting or in shock, the oral route is preferable for the administration of food and liquids. Both clinical and laboratory data must be considered in determining the amount of plasma to be given. If the patient remains in shock, plasma administration must be continued. If he is not in shock various guides may be used. Serial hematocrits are a valuable source of information. Harkins suggested the following formula as a guide to plasma dosage: give 100 cc. of plasma for each point the hematocrit exceeds 45. The extent of the burn is used as the basis for the following measure: give 100 cc. for each per cent of body surface burned over 10%. The plasma is given at a rate approximating that of fluid loss:

$\frac{1}{2}$ in 4 to 6 hours
$\frac{1}{4}$ in the next 6 hours
$\frac{1}{4}$ in the next 12 hours

a

b

c



d

e

Fig. 4. Neglected Burn

This child had remained at home, without medical care for 3 months after a third degree burn of the lower extremity

uded area, the flexion con-

c. Contracture corrected

d. Split skin grafts have been used to resurface denuded areas and function has been restored.

e. The reconstructed popliteal region.

1000 cc. of 5% glucose in saline is probably adequate for the average adult in the first twenty-four hours and there are definite dangers to overzealous administration of saline.

It should be mentioned that there is evidence to indicate that whole blood may have a rational place in the replacement therapy of burn shock. McDonald, Cadman and Scudder point out that whole blood transfusions plus electrolyte solution by mouth are effective in combating burn shock and also in preventing the anemia which develops during the convalescent period. In general, plasma losses predominate in extensive second degree burns while in third degree burns there may be additional considerable loss of red cell mass.

After shock treatment has been instituted, dressings are applied to the burn. At this point a warning should be voiced against vigorous debridement which compounds shock and definitely increases morbidity. At this hospital no debridement is performed except in very grossly contaminated cases and in those cases it takes the form of very gentle sponging with warmed saline. Blisters are left intact in all cases. These procedures as well as the dressing of the burns are carried out under sterile conditions with all personnel gowned and gloved.

Since World War II the most popular local burn treatment has been that of pressure dressings over fine mesh gauze, either dry or impregnated with petrolatum or boric acid ointment. At this hospital a 70% cod liver oil ointment* is preferred because in third degree burns it speeds the separation of the slough and shortens the pre-grafting period. This ointment does not damage adjacent eipthelium, does not interfere with healing of second and first degree burns, and by its collagen stimulating properties provides a base suitable for grafting in areas of full thickness loss.

The ointment dressings are applied to the burn area and are carried well beyond the obvious lesion because the actual burn is usually more extensive than its immediate appearance suggests. Over this initial layer, a bulky layer of fluffed sterile gauze or sterile mechanics waste is placed, and even compression is produced by the use of a firm, wide bandage or elastic bandage. On the extremities, pressure dressings must extend distally to cover the remainder of the extremity to prevent the edema that proximal compression would otherwise cause. It is well to incorporate splints in the dressings of burns of extremities. Many authors recommend the application of close fitting Plaster of Paris casts to achieve pressure and splinting. This technique is fraught with the dangers of circulatory impairment and gangrene.

Pressure dressings are not very practical in the treatment of burns of the face, head, neck, genitalia and the anal region. These areas are merely covered with a layer of ointment and thin dressings which are changed at frequent intervals on the ward. In severe burns of the buttocks no dressing is applied but the patient is placed on a soft sterile towel to which the ointment has been applied. Upon turning the patient another towel may be greased and laid upon the lesion.

The initial dressings on burns of the extremities or trunk are usually left unchanged for 10 to 14 days. If there is gross seepage through the dressings or if

* Gadoment.

they slip, they are merely reinforced or extended without being removed. Burns of the hands and fingers present somewhat of an exception to the rule and are dressed rather frequently. Since there is such a great degree of disability as a result of prolonged immobilization of fingers, it is good practice to start a regime of daily warm saline or water baths with active finger and wrist motion at the end of the first week after injury.

In 1944 Connor and Harvey described a new method of slough removal using Pyruvic acid in a water starch gel. Subsequent studies by Sulzberger, Kanoff and Baer indicated that a number of preparations were equally effective in the acid debridement of burns.

In a brief trial on this service the acid debridement has not proved particularly useful. Considerable pain and irritation has resulted from use of the acid media. The compounds have been expensive and unstable, and their use has failed to significantly shorten the course of extensive burns.

The very early excision and skin grafting of deep burns has never been considered practical by this service.

The value of chemotherapy as a prophylactic measure against infection has been extensively discussed. It has been the practice at Kings County Hospital to administer penicillin by the intramuscular route, routinely to all deep burn cases from the time of the initial dressing until the first redressing. In the majority of cases, this therapy has been continued until the burn was entirely epithelialized, either by natural processes or by skin grafting. Under this regime, infection has not been a serious problem at any time. Elman, *et al.* have given sulfathiazole by mouth, routinely for the first week and reserved the use of penicillin to preparation for skin grafting. Lund, *et al.* point out the dangers of the administration of sulfonamides over a long period of time and question the effectiveness of these drugs against the organisms which usually contaminate burns. They do not believe that penicillin administered intramuscularly is very effective, either, unless the predominating organism is shown to be the hemolytic streptococcus.

Hyperpyrexia is a serious complication which is sometimes manifested by burn cases in the first few days following the injury. It is seen most frequently in infants and children but may occur in adults who have very large surface areas involved. Delirium, stupor or convulsions frequently accompany the hyperpyrexia. If the temperature of the patient remains above 106° F. for many hours, death will result, so energetic measures are necessary to treat this complication. Therapy includes intravenous fluids, ice-water sponge baths and exposure to draughts.

The maintenance of a good nutritional status is a vital element in the care of the burned patient. Elman stresses the advantages of the oral route over parenteral methods in feeding the burn case. Large quantities of fluids containing electrolytes and protein should be provided. Fluid intake should be sufficient to maintain a urinary output of between 1000 and 1500 cc. daily, after the first day. When necessary, tube feedings or intravenous administration of carbohydrate-protein hydrolysate mixtures may be resorted to. The importance of

a high protein intake to balance the large nitrogen losses has been pointed out. It has also been indicated that there is evidence to recommend a high vitamin intake in burn cases. Levenson, Green and Lund recommend the following nutritional intake in burn cases of 20% of the surface area:

PROTEIN	CALORIES	ASCORBIC ACID	THIAMIN	RIBOFLAVIN	NICOTINAMIDE
gm.		gm.	mg.	mg.	mg.
300–400	5000	2 0	50	50	500

It is very difficult to fulfill the nutritional requirements of severely burned patients because of the anorexia associated with their injuries and also the unpalatability of most concentrated protein supplements.

A preparation which has proved useful in supplementing the diet of burn cases at Kings County Hospital is a chocolate flavored mixture of hydrolysate of yeast and meat proteins, carbohydrate, and the Vitamin B complex. When this material is administered in milk, four tablespoonsful three times a day provide:

Protein	86 gms	Pantothenic Acid	10 mgs.
Carbohydrate	92 gms.	Vitamin B_6	1.6 mgs.
Vitamin B_1	13.2 mgs.	Biotin	0.24 mgs.
Vitamin B_2	20 mgs.	Folic Acid	0.8 mgs.
Niacinamide	13 2 mgs.	Choline	240 mgs.

This, of course, is in addition to the ordinary hospital high protein diet (120 to 140 gms per day) and the usual vitamin supplements.

Anemia is a fairly common complication after the second day. It is most marked in deep and extensive burns and in infants and children. Many factors may participate in causing the anemia. Some of those suggested, are:

1) Early hemolysis and cell fragility.
2) Blood destruction by un-neutralized plasma antibodies.
3) Blood loss through an open wound.
4) Infection.
5) Disordered iron metabolism and depressed marrow function.
6) "Alarm reaction," or "adaptation syndrome."

There is impaired utilization of iron in the anemia of burns so that transfusion is the only really effective method of restoring the hemoglobin level after it has fallen. Maintenance of normal hemoglobin and plasma protein levels is essential to proper healing and successful grafting of burns.

SKIN GRAFTING OF BURNS

The primary goal in full thickness burns should be the early and complete coverage with skin, and it is toward this goal that all therapy should be directed. The techniques used to produce local conditions favorable to grafting are varied. Levenson and his associates use no special methods and merely continue to apply infrequently changed dry dressings until the desired state is achieved. Elman prefers to use wet saline packs. The pyruvic acid method of Connor and Harvey

has been noted in an earlier section of this paper. At Kings County Hospital the 70% cod liver oil* ointment previously mentioned is used until the slough has separated and the granulations are firm and pink. As soon as this highly desirable condition obtains, the cod liver oil ointment is discontinued and a dressing of a nitro furan compound† is applied to the granulations for a period of from 24 to 48 hours before grafting. This ointment is quite effective in eliminating mild surface infections which sometimes remain after separation of slough, and it also tends to inhibit the development of exuberant granulations. In treating burned children, we have found tub baths to be an effective adjunct in speeding the separation of slough and eliminating wound infections. As a rule, deep burns are ready to be grafted in 18 to 21 days when the technique described above is used. Not only is the local wound condition important in the grafting of burns but also, as has been previously stated, the patient's nutritional status must be maintained if successful "takes" are to be achieved. Patients should not be grafted until their hemoglobin and plasma protein levels are relatively normal and any considerable blood loss in the operating room should be promptly replaced.

Medium or thick split skin grafts are used to resurface third degree burn areas. The Padgett dermatome has made it possible to cut sheets of skin calibrated to even thickness from almost any part of the body in sections up to 4 inches by 8 inches. The thickness of skin which should be used is a question of surgical judgement with which a number of factors are concerned. The thinner a split graft is cut, the more likely it is to be a successful "take". On the other hand, the thicker a graft is cut the less likely it is to contract badly. Again, the thinner the graft is taken, the quicker the donor site will heal. These factors must be considered together with the availability of donor sites and the thickness of those donor sites. There is considerable variation in the thickness of the more commonly used donor sites. The abdomen and inner sides of the thighs are considered rather thin skin, whereas the lateral sides of the thighs, the chest and back are covered with fairly thick skin. Women and children have relatively thinner skin than adult males. It has been our practice to cut grafts for open wounds thinner than for closed ones. In general at this hospital grafts are cut at .012 to .013 inch thickness for burn coverage in adults, and .008 to .010 inch thickness in young children. The area of skin which is grafted at one operation will depend upon the condition of the patient. As a rule, four drums of skin (128 square inches) is considered about the maximum amount which can safely be transferred at one operation, and in most cases it will be found expedient to limit the operation to two drums.

The technical details of the use of the dermatome and the fixation of grafts are not especially pertinent to this discussion. We use automobile "feeler" gauges to adjust the level of the dermatome blade and suture the graft to the recipient areas. When the granulation tissue is young and firm, it is not disturbed but when the recipient area is covered with old, exuberant granulation tissue, the

* Gadoment.
† Furacin.

granulations are stripped off down to a firm, yellow base. Bleeding is controlled by warm saline packs and the graft is then applied. Basting sutures improve

a

b

FIG. 5. EXTENSIVE, THIRD DEGREE BURNS IN A 42 YEAR OLD WHITE MAN

This is the only death from liver necrosis seen on this service

a. Burned area shortly after admission. This picture demonstrates the hard leathery eschar seen in deep burns.

b. Burned area after separation of eschar and slough.

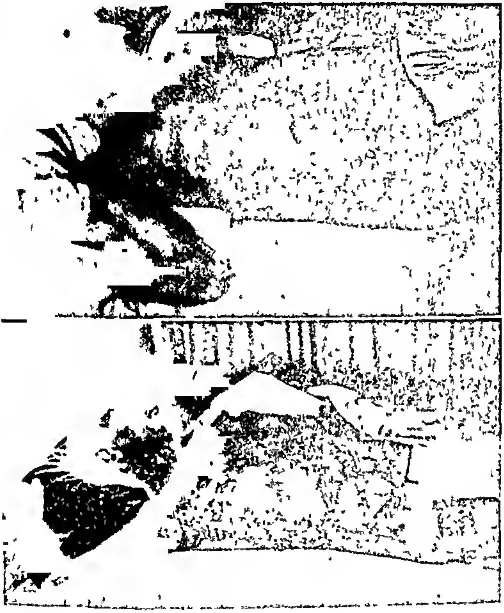
c. Multiple split skin grafts in situ. This patient was grafted in bed, on the ward, because of his desperate physical condition.

d. Burned area is completely epithelialized but patient is moribund because of liver damage. Ascites is apparent.

the fixation of large grafts and "pie crust" incisions are sometimes used for stretching skin where large areas are denuded and donor areas are meager.

When concave surfaces are grafted, it is convenient to use a gauze roll as a stent, tied firmly over the graft by sutures which have been left long for this purpose. Pressure dressings are always applied over the graft. If the graft is on an extremity or in the axilla or inguinal region, plaster of paris casts are valuable to insure immobilization of the part.

d



c

FIG 5

Grafts are usually redressed in seven to ten days, unless there is evidence of infection at an earlier date. A graft may be inspected or dressed as early as three days post-operatively if care is taken to avoid stripping it from its new bed, and if pressure and immobilization are reinstituted. Barring complications, dressings are left on donor areas for two or three weeks by which time the areas have usually healed and need no further dressings.

SOME SPECIAL CONSIDERATIONS IN THE MANAGEMENT OF BURNS

Burns which involve the skin over or adjacent to joints require careful splinting if late, crippling complications and sequelae are to be prevented or minimized. It is these areas also which most urgently require early grafting. Severe burns of the popliteal or the antecubital regions are best held in extension to prevent flexion contractures. Extension is a desirable position for burns over the hip joint and inguinal region and abduction of the shoulder tends to minimize contractures in axillary burns. Severe burns of the hands and fingers can be very crippling. The characteristic contracture seen following burns of this area is one with the metacarpophalangeal joints in extension and the interphalangeal joints in flexion. This deformity renders the hand almost useless. During the first week, the fingers are immobilized in a position which gives flexion at the metacarpophalangeal joints and extension of the interphalangeal joints. However, the most important factor in salvaging the burned hand is the early institution of a full range of active motion in daily saline baths. The latter measure should be started at the end of the first week. It must be interrupted when the part is grafted but should be reinstituted as early as possible thereafter. During the convalescent period from burns which involve joint regions, hands or fingers, the physiotherapy and occupational therapy departments can give valuable assistance in restoring function.

Burns may result in contractures which require corrective surgery despite splinting and early grafting because of the well known tendency of split skin grafts to contract. A detailed discussion of the management of these late problems would involve a lengthy volume on plastic surgery. Surgery must be individualized to meet the needs of each specific case. J. S. Davis and Ferris Smith have emphasized the value of the Z-plastic operation which can be used to correct contractures of hands, fingers and other joints. As a rule pedicle or tubed flaps are the only effective means of treating neck contractures. Contractures on the face and about the eyes are often best treated with free full-thickness grafts. In some other areas, it is expedient to surgically free the contracture and use a free thick split skin graft to surface the resulting defect.

The inability of the split skin graft to withstand prolonged trauma is another factor which may necessitate corrective measures in burn cases. Thus, it may eventually be necessary to place full-thickness grafts on fingers and over the dorsum of the hand, while pressure bearing areas such as the sole of the foot and the palm of the hand may need pedicle flaps.

Contractures are not the only late sequelae of burns. Unstable scars, ulcers and occasionally malignancies are noted. Unstable scars and ulcerations are presumably due to development of ischemic fibrous tissue subcutaneously with thin overlying epithelium. The etiology of malignancy is of course not completely understood. Generally following burns the type is squamous cell carcinoma. Old burn ulcers are treated by radical excision and grafting, but biopsy should be performed on all such ulcers before definite therapy is instituted.

CONCLUSIONS AND SUMMARY

The management of severe burns has been discussed. Outline for therapy is based on modern concepts and experiences with the treatment of more than fifteen hundred cases whose burns were severe enough to require hospitalization.

I *Initial Treatment Period.*
- A Shock prevention or treatment by administration of plasma and crystalloid solutions.
- B. Little or *NO* debridement.
- C. Application of cod liver oil ointment and pressure dressings

II *Period of Supportive Treatment*
- A Original dressing left intact for seven to ten days Dressings every four to seven days thereafter using cod liver oil ointment
- B Prophylactic Penicillin.
- C Maintenance of Nutrition (Protein and Vitamins)
- D Maintenance of Hemoglobin—whole blood transfusions
- E Splinting burned extremities.

III. *Grafting*
- A. *Preparations for grafting.*
  1. Tub baths.
  2. Furacin dressings 24 to 48 hours pre-operatively
- B *Operation.*
  1. Use of Padgett Dermatome.
  2. Dressings of Furacin.
  3. Pressure Dressings
- C *Post-Operative.*
  1. Dressings in 7 to 10 days if uncomplicated
  2. Donor site dressed in two to three weeks

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FINAL REPAIR OF THE SEVERELY INJURED HAND

ROBERT M. McCORMACK, M.D.

In a review of plastic surgery in World War I and in World War II Davis (1) emphasized the recent policy of grouping hand injuries requiring reconstruction hand centers. This policy followed the recommendations of Bunnell (2) and, as he stated, "for the first time in any war hands were treated as an entity." The hand surgeon combined the principles of the specialties—plastic surgery, orthopedic surgery and neurosurgery—to plan the extensive reconstructions of the severely injured hands. At times this intricate reconstructive plan was complicated by the necessity for the closing of various hand centers with the subsequent transfer of large numbers of patients to another center. Thus an unique opportunity was encountered on the Hand Section, William Beaumont General Hospital, because of the concentration of large numbers of the most severely injured hands. The final repair of the partially reconstructed hand required the most careful planning to utilize the structures present for the greatest functional advantage without jeopardizing normal parts or tissues already repaired.

The reconstructive surgeon must evaluate the individual tissues of the hand and arm—skin, bone, joint, tendon and nerve—then correlate these findings to plan the surgical procedures. In addition in the partially reconstructed hand one should attempt to carry out the original over all plan, if surgically feasible, rather than destroy what has already been accomplished merely to employ procedures of personal preference.

Surgery of the bones, joints, tendons and nerves must necessarily await adequate soft tissue cover of skin and subcutaneous tissue. Koch (3), Kitlowski (4), Kiskadden (5), Shaw (6) (7), Webster (8) and Brown (9) have all carefully described the plastic procedures to obtain pedicle flap skin, preferably with no raw surface, for adequate cover of the forearm and hand. On admission most patients transferred from other hand centers had adequate skin cover. However, repeated stress should be given to the careful placing of incisions not only to prevent future skin contractures but to enable later deep repair to be done under the flap rather than through overlying scar. The skin, vessels and nerves of a finger being amputated for irreparable damage may judiciously be used as a filet flap to cover a defect of excised cicatrix as in Figure 1.

Bone surgery of the hand consisted of three main types: 1) iliac bone grafts with Kirschner wire fixation for the replacement of loss of bone substance of the metacarpals or phalanges, 2) arthrodesis of the wrist in a position of function as a step in the over all plan for use of the wrist flexors or extensors as motor powers for future tendon transfers and 3) osteotomy and shifting of the index or little metacarpals to the adjacent metacarpal base as reported by Saedecor (10) and

From The D... ent of Surgery, University of Rochester School of Me... York, and The Hand Section, William Beaumont G...

Hyroop (11). Less frequent procedures were: iliac bone block between the thumb and index metacarpals, arthrodesis of a short thumb in a position of function, pollicization of the partially amputated index finger with intact nerves for complete loss of the thumb as outlined by Bunnell (12) and Kelikian and Bintcliffe (13).

FIG 1a, b, c Irreparable damage to the bones, joints and tendons of the long and ring fingers and malunion of the little metacarpal. d, e, f, g Result following filet amputation of the long and ring fingers with the proximal phalanx used as a transverse bone graft, osteotomy and shift of the little metacarpal and the skin, vessels, and nerves used as a filet flap to cover the defect of excised cicatrix.

Bunnell (14), Koch (15), Young (16), Graham (17), Luckey and McPherson (18) and May (19) have repeatedly stressed the absolute necessity for mobile joints in the hand before any secondary tenorrhaphy, tendon graft or tendon transfer can hope to be successful. Stiff joints must also frequently be mobilized after thick split thickness skin grafting of the burned dorsum of the hand. Mobilization of joints resulted from prolonged use of the hand, including occu-

pational therapy, and could be hastened by gentle elastic traction applied with a cock up or knuckle bender splint of Bunnell (20) under the direct guidance of the operating surgeon. The more severe joint contractures frequently required capsulectomies of the metacarpophalangeal joints Bony ankylosis of the metacarpophalangeal joint could be corrected by arthroplasty, as reported by Fowler (21), if the tissues of the finger justified the procedure Capsulectomies or

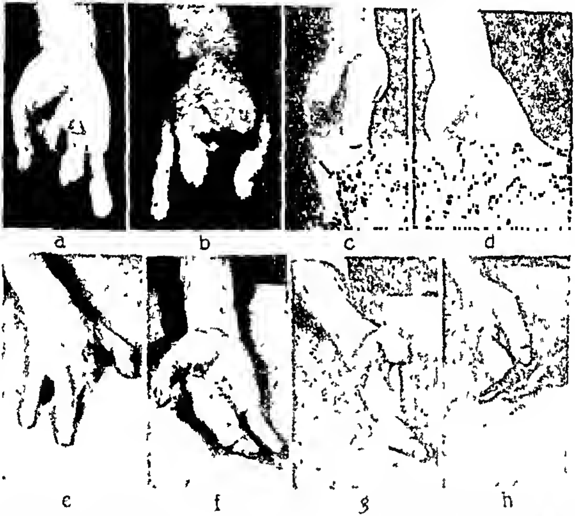

FIG 2a, b, c Traumatic amputation of the index finger and the long finger with severe flexion conte… [illegible] …tial excision of cicatrix and … and nerves … resection of

arthroplasties of ankylosed interphalangeal joints were not done, the procedure of choice being arthrodesis in a position of function with Kirschner wire fixation

The severely paralyzed, partially ischemic hands, stiffened by long periods of non-use, and showing no motor return after previous careful neurorrhaphies presented the most difficult final reconstructive problems If the peripheral nerve showed no evidence of return one and one-half to two years after neurorrhaphy at the forearm or upper arm level, we advised tendon transfer procedures utilizing as motor powers the available non-paralyzed muscles that would not jeopardize the total function of the hand. If necessary, arthrodesis of the wrist in a position of function was done to stabilize the hand and to obtain motor

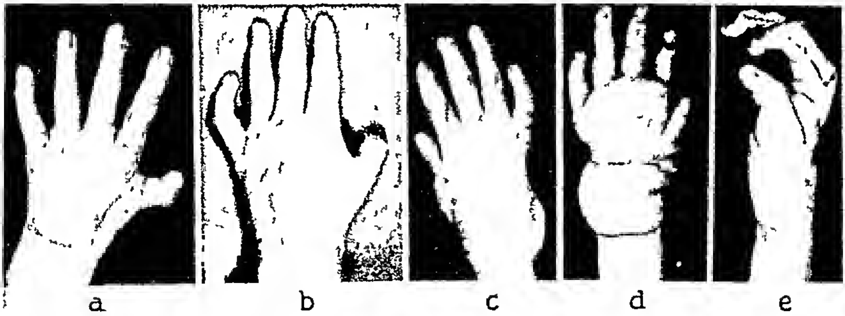

FIG. 3a, b. Left hand with split thickness skin graft of burned dorsum and severe extension contracture of the thumb corrected by arthrodesis of the metacarpophalangeal joint in a position of function. c, d. Right hand with severe burn contracture of the dorsum and thumb. e Appearance at the first dressing following split thickness skin graft of the dorsum of the fingers, capsulectomies of the metacarpophalangeal joints, revision of the volar pedicle and arthrodesis of the metacarpophalangeal joint of the thumb at one operation.

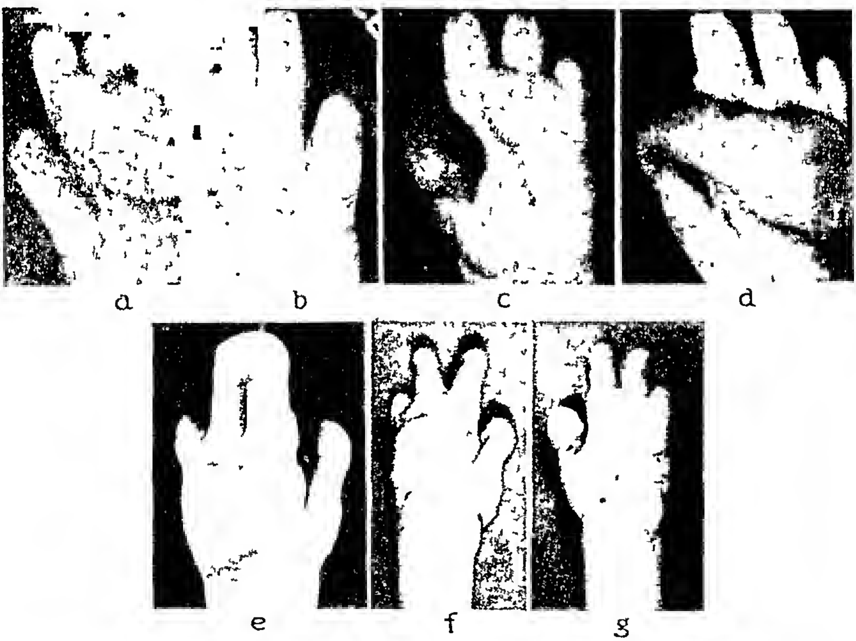

FIG. 4a, b. Complete loss of the thumb, partial loss of the long, ring and little fingers with pollicization of the index metacarpal begun at another center. c, d, e Arthrodesis of the index metacarpal as the new thumb and cover of the scarred, tender digital tips with pedicled skin following neurotomies f, g Final result following revision to preserve length.

powers. A wide variety of motor powers were used, the specific muscle depending on its availability, freedom from binding cicatrix, electrical response preoperatively and range of motion at the time of operation.

The most common tendon transfer was performed for loss of extension of the fingers and thumb due either to traumatic loss of extensor musculature or to radial palsy. The original procedures of Jones (22) were utilized with modifications as reported by Altman and Trott (23), Zachary (24), Young and Lowe (25) and Luckey and McPherson (18). We also feel that the best results are obtained when the transfers are carried out through multiple small incisions leaving one wrist flexor tendon intact. The severe fibrosis of the extensor musculature in these late cases made it necessary to sever the recipient extensor tendons proximal to the point of suture in order to obtain a functional angle of pull and range of motion. In general one can expect very satisfactory active extension of the fingers and thumb to the full degree of possible passive extension.

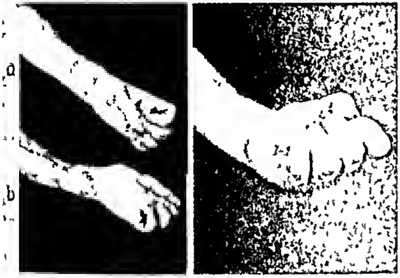

Fig. 5

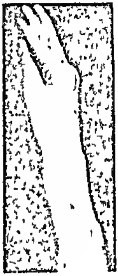

Fig. 6

Fig. 5a, b Paralysis of the median and ulnar nerves with satisfactory sensory return following median neurorrhaphy and ulnar neurolysis Excellent opponens tendon transfer at another center prior to admission. c. Functional result following transfer of the little, long and index sublimi flexor tendons to correct the ulnar motor paralysis of the intrinsic muscles

Fig. 6. The Deformity of Local Ischemic Contracture of the Hand

The opponens tendon transfer of Bunnell (26), preferably utilizing the ring finger sublimis flexor after Royle (27), gave satisfactory results using the indications, technics and post-operative care as reviewed by Kirklin and Thomas (28). Many times this transfer had to be done in spite of satisfactory sensory return from a median neurorrhaphy. The flexor sublimis tendon transfers to restore intrinsic muscle action in ulnar palsy using the technics of Bunnell (29) gave fair results in our cases. Flexion of the mobile metacarpophalangeal joints appeared to be restored more easily than extension of the distal two interphalangeal joints. However, as Luckey and McPherson (18) point out, this transfer is indicated only in the more severe claw hands and if the ulnar palsy includes the flexor profundi tendons of the ring and little fingers the flexor sublimis tendon of the index or long finger must be used, giving less satisfactory results.

Figure 6 illustrates the position assumed in local ischemic contracture of the

hand as described by Bunnell (30). The ischemic fibrosis of the intrinsic muscles of the hand draws the metacarpophalangeal joints in to partial flexion, extends the distal two interphalangeal joints and adducts the thumb. In retrospect this deformity, the mechanical opposite of the claw hand of ulnar palsy, was seen fairly often in these severe, late hand injuries.

The partially amputated hand required restoration of the remaining parts to optimum function, frequently using as motor powers the proximal portions of tendons severed in the amputation. At times it was impossible to avoid crossing cicatricial lines left by the amputation. In the most severe cases the transfers were planned to combine with a future partial prosthesis of the hand to give a strong, controlled range of motion to the remaining sensitive parts. Terminal neuromas of the severed volar digital nerves were common and were treated by careful isolation, ligation with a non-absorbable suture material and replacement

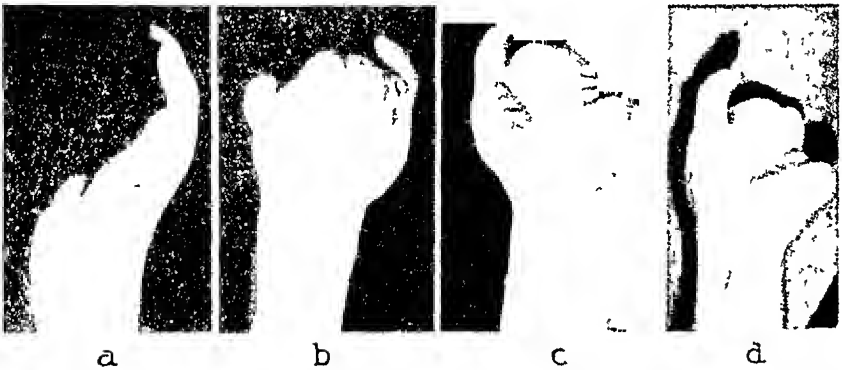

FIG. 7a, b, c. Bilateral severe partial amputations of the hands. d. Result following mobilization of the short thumb and malaligned little finger by deepening the webs with Z-plasty and skin graft and capsulectomy of the little finger metacarpophalangeal joint. The patient was able to touch the tip of the little finger to the tip of the thumb.

in deep tissue. Severed nerves were repaired with 7-0 silk wherever possible to give all-important sensation to the remaining parts. Surgical procedures with a considerable element of possible failure and subsequent irreparable disability to the hand were avoided, granted that such procedures were surgically possible and under less severe conditions definitely indicated. An example would be a rotatory osteotomy of the fractured little finger metacarpal in Figure 7 to gain improved position for pinch with the partially amputated thumb. This patient had severe bilateral partial amputations of the hands with the remaining right little finger the best functional digit. At another center reconstruction of the right thumb by tubed pedicle skin and iliac bone graft had failed due to infection. Therefore, following sequestrectomy and healing, we emphasized mobilization of the short thumb and the malaligned little finger by deepening the webs by z-plasty and a skin graft plus a later capsulectomy of the metacarpophalangeal joint of the little finger, thus gaining a strong, functional hand.

Indications for all of the discussed procedures were considered in relation to the future work of the patient A great majority of the men had to earn their future livelihood with their hands Therefore we felt that strong, stable gross movements from a position of function should take precedence over futile attempts to gain fine individual variations of motion in these severely injured hands

SUMMARY

A surgical advance of World War II was the establishment of hand centers to treat the injured hand as an entity, following the recommendations of Bunnell The hand surgeon utilized the principles of plastic surgery, orthopedic surgery and neurosurgery to plan the extensive reconstructions In the partially reconstructed, severely injured hand special care should be taken to consider final repair by further surgical procedures in relation to 1) the original reconstructive plan, 2) the present status of the hand, 3) possible complications and irreparable disability and 4) the future use of the hands

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BLOOD SUPPLY OF CROSS LEG PEDICLE FLAPS*

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The cross leg pedicle flap is an expedient method for the transplantion of whole-thickness skin and subcutaneous tissue to a defect of the foot or leg. If the girth of the donor calf or thigh be sufficient to furnish a graft of adequate size and if the mobility of joints of the hips and knees be sufficient to assume the planned post-operative position, it is possible to cover a defect in any area of the leg or foot. From the point of view of the comfort of the patient, a consideration of paramount importance, the medial calf and the anterior thigh offer the best donor sites upon which to construct pedicle flaps. The posterior calf and the medial aspect of the thigh also have been used as donor sites for either open or tubed pedicles. The relative vascularization of the soft tissues of the various areas of the lower extremity cannot be determined by reference to standard texts of anatomy. Anatomical study shows that many of the large arteries course deep to the skin and subcutaneous tissues and do not contribute superficial branches at regularly spaced intervals.

It is the purpose of this paper to show which of the donor areas in popular use has the greatest number of blood vessels. It is reasoned that the areas which have the greatest number of blood vessels have the best anatomical background for the development of surgically successful flaps.

METHOD OF STUDY

Several methods were used to gain information concerning the location of macroscopic arteries of the various surface areas, the size of their arteries and their relative, quantitative vascular beds. Cadavers from the anatomical laboratory were used. These had been embalmed recently but the embalming fluid had been suctioned out of the arterial tree once the soft tissues had been "fixed". In one case an unembalmed refrigerated cadaver was used. After withdrawing the embalming fluid from the arteries, commercial Umbrathor (Colloidal thorium dioxide, 24–26%) was injected into the arterial tree through a cannula in the femoral artery. The degree of filling was determined by x-ray examination of the extremity. Approximately one hundred cubic centimeters were necessary to fill the vessels in the areas involved in this experiment. Once filling had been accomplished, circumferential flaps of whole-thickness skin and subcutaneous tissue were cut from the extremity, just above and just below the knee. These circumferential flaps of tissue were four inches in vertical dimension. They were removed completely from the extremity, the line of dissection being accurately placed at the junction of subcutaneous tissue and fascia. The upper margin of the circumferential flap of the leg was at the level of themedial

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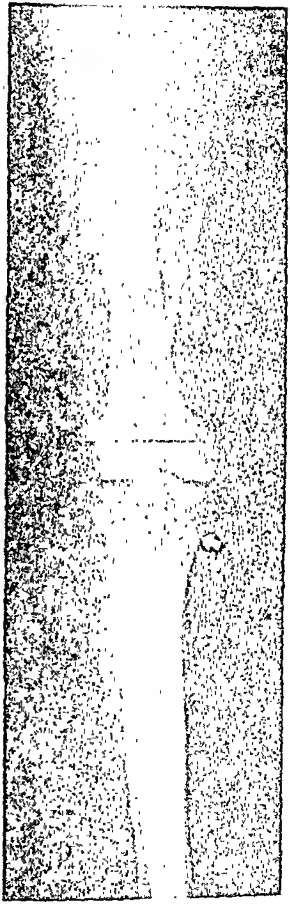

Fig. 2. Cadaver "B"

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condyle of the tibia and the head of the fibula with its vertical incision along the crest of the tibia. The flap taken from the thigh extended four inches proximal to a line drawn transversely between the condyles of the femur, with its vertical incision along the gracilis muscle. The width of these flaps and the areas from which they were taken correspond to the donor areas used most commonly in the cross leg flap procedure. The size of the usual pedicle flap allows only three possible donor areas in the leg: medial, posterior and lateral. The thigh affords four possible donor areas: anterior, medial, posterior and lateral. In an endeavor to determine the relative vascularity of the three available donor sites of the leg, the circumferential band of whole-thickness skin and subcutaneous tissue was divided by lead markers into equal medial, posterior and lateral thirds. The same procedure was used upon the flap from the thigh where four possible donor sites were demarcated equally. X-rays were taken of these circumferentail flaps. Inspection of the x-rays showed the arteries that reach the tissues of the surface accurately outlined by the opaque medium.

In the second method of study a refrigerated unembalmed cadaver was used. The vascular tree of the right lower extremity was washed out with physiological saline. The femoral vein was incised so that the unclotted blood might escape. After clear saline returned through the venous circuit, liquid latex rubber was injected into the arterial tree. After the body had been refrigerated for approximately a month, a circumferential flap was cut below the knee as outlined previously. The flap was subdivided by incision into three equal donor areas. Each rectangular block of tissue was placed into a separate basin where all soft tissues were digested by a solution of sodium hypochlorite, according to Danforth's method (1). The tissue digestion left the unaffected latex vascular casts. Since the latex filled only the arterial tree, the casts represented molds of the arteries of the skin and subcutaneous tissue. These molds were weighed on chainomatic balances.

OBSERVATIONS

Cadaver "A": After the tissues were "fixed", the arterial tree of the right lower extremity was suctioned. Colloidal thorium dioxide was then injected into the femoral artery. X-rays of the thigh and leg were taken. The circumferential flaps of skin and subcutaneous tissue were then excised cleanly from the fascia of the leg and the thigh. These were x-rayed. Study of the x-rays of the extremity in comparison with those of the isolated flaps gave information as to the identity of the nutrient major artery or arteries for each detached flap. Information was gained which showed that a flap from the medial third of the calf is supplied by the posterior tibial artery and the medial inferior geniculate artery. The flap from the lateral third of calf was shown to be supplied by the peroneal artery. The flap from the posterior third of calf was shown to be supplied by the popliteal artery. All four of the flaps from the thigh, the medial, the anterior, the lateral and the posterior were shown to be supplied by the third deep perforating branch of the femoral artery. The total lengths of these supplying vessels were calculated by means of a Map Measure*. The total lengths

* Manufactured by: Leitz, Germany; Keuffel & Esser, Switzerland.

of arteries of the respective donor areas were: medial third of the calf—90 cm., lateral third of the calf—57 cm.; posterior third of the calf—53 cm.; anterior quarter of the thigh—72 cm.; medial quarter of the thigh—67 cm., lateral quarter of the thigh—56 cm.; posterior quarter of the thigh—42 cm.

Cadaver "B": The flap from the medial third of the calf was shown to be supplied by the saphenous, the posterior tibial and the medial inferior geniculate arteries. The flap from the lateral third of the calf was shown to be supplied by the anterior tibial artery. *The flap from the posterior third of the calf* was

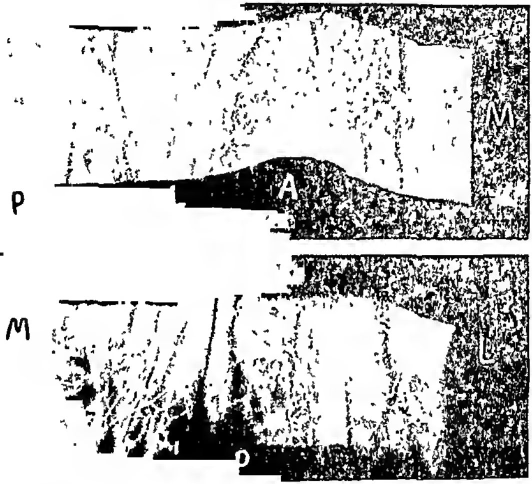

Fig. 3. [illegible] (below) [illegible] Cadaver "A". By [illegible]
arteries b [illegible]
(A) and t [illegible]
lateral (L [illegible]

shown to be supplied by the popliteal artery. The flap from the anterior and posterior quarters of the thigh were shown to be supplied by the third deep perforating branch of the femoral artery. The flap from the lateral quarter of the thigh was shown to be supplied by the third deep perforating branch of the femoral artery and the lateral superior geniculate. The flap from the medial quarter of the thigh was shown to be supplied by the highest geniculate artery. The cumulative lengths of these supplying vessels to the respective donor areas were: medial third of the calf—120 cm.; lateral third of the calf—103 cm.; posterior third of the calf—61 cm.; anterior quarter of the thigh—126 cm.;

lateral quarter of the thigh—110 cm.; medial quarter of the thigh—107 cm.; posterior quarter of the thigh—72 cm.

Cadaver "C": The flap from the medial third of the calf was shown to be supplied by the posterior tibial, the saphenous and the medial inferior geniculate arteries. The flap from the lateral third of the calf was shown to be supplied by the peroneal artery. The flap from the posterior third of the calf was shown to be supplied by the popliteal artery. The cumulative lengths of these supplying vessels to the respective donor areas were: medial third of the calf—72 cm.; lateral third of the calf—22 cm.; posterior third of the calf—10 cm. No flap was taken from the thigh.

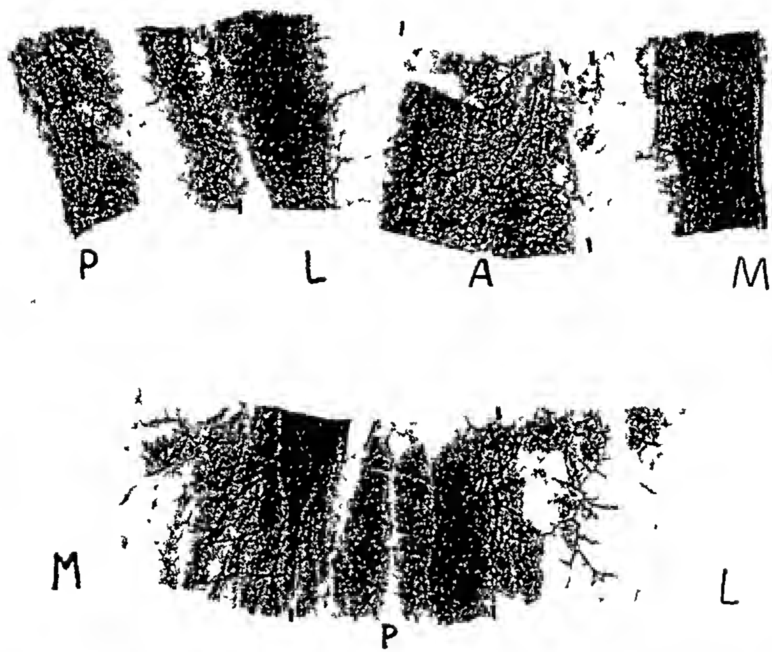

FIG. 4. Circumferential flaps from thigh (*above*) and leg (*below*) of Cadaver "B". Calculated total lengths of supplying arteries show them to be most abundant in the superficial tissues of the anterior thigh (A) and the medial calf (M).

Cadaver "D": Quantitative study of the vascular bed of the skin and subcutaneous tissue of the lower extremity was made by the use of the method of latex injection of the arterial tree. Flaps were prepared as outlined above and then each was placed in a separate basin containing commercial chlorox*. This solution digested the soft tissues leaving the latex rubber unaffected. The rubber casts of the arterial tree in each flap were cleaned and weighed upon chainomatic balances. The cumulative weights of the latex casts were: medial third of the calf—123 mgm.; lateral third of the calf—11 mgm.; posterior third of the calf—no vessels filled.

* Sodium hypochlorite, the active ingredient, is liberated.

DISCUSSION

When the lower extremity is used as a donor area for the contralateral foot or leg, the entire circumference of the calf and the thigh presents itself as a possible donor site in the hypothetical positioning of a cross leg pedicle flap There is no agreement concerning the positions of choice upon which to base these pedicle flaps The medial calf and the anterior thigh may be utilized with maximum comfort to the patient The posterior calf is also used frequently The medial thigh is a frequent site for a tubed or an open pedicle flap

The observations reported herein indicate that the medial calf and the anterior thigh are donor sites of choice since it has been shown that arteries are most abundant in these areas The posterior calf and the posterior thigh show the fewest arteries It is known that pedicles from the posterior third of the calf may be used with success if cautiously delayed, but this area is not the donor site of choice, and its indiscriminate use may lead occasionally to failure The lateral third of the calf has an arterial supply second to that of the medial third of the calf, but it is usually difficult to base a pedicle upon that surface The medial thigh has somewhat fewer arteries than has the anterior thigh but the difference is not great Clinically this area has been used principally for tubed pedicles, with success

Most commonly the arteries that supply the medial third of the calf are the posterior tibial, the medial inferior geniculate, and the saphenous The caudal dip that the medial inferior geniculate artery makes under the medial condyle of the tibia (See Figures 1 & 2) allows it to supply the superficial tissues of the calf more effectively than the horizontal lateral inferior geniculate The vessel that supplies the anterior thigh most commonly is the third deep perforating branch of the femoral artery

SUMMARY

Anatomical observations on the abundance of arteries in the skin and sub cutaneous tissues of the thigh and leg are presented These observations were made by the study of rectangular flaps of tissue cut from above and below the knee The arterial systems of the flaps were visualized by x rays taken after injection of the arteries with radiopaque solution Photographs of x rays are shown Also, quantitative studies of the arterial bed of flaps of soft tissue were made by the preparation and the weight measurement of latex casts of the arterial trees of the flaps Both studies yielded data which shows that arteries are more abundant in the medial aspect of the upper one third of the leg than in the outer or posterior aspects of the upper third of the leg Also the data shows that arteries are more abundant in the skin and subcutaneous tissues of the anterior aspect of the lower third of the thigh than in the medial, posterior or lateral aspects of the thigh These observations lend laboratory support to the popular clinical selection of the anterior thigh and the medial calf as donor sites of choice for the construction of cross leg pedicles

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THE PLASTIC SURGICAL TREATMENT OF PSEUDOXANTHOMA ELASTICUM

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The present study was suggested by repeated statements in the literature that no means or method is available for the treatment of psuedoxanthoma elasticum or the sequelae of the disease although the residual deformity may be, at least in some instances, conspicuous and embarrassing. The surgical literature is lacking in any reference to the cutaneous deformities in the disease, which can be corrected through the application of simple plastic surgical procedures, as will be demonstrated in an instance to be presented here.

CLINICAL FEATURES, CHARACTERISTICS AND SYMPTOMS OF THE SKIN DISEASE

Pseudoxanthoma elasticum was described in 1896 by Darier (1). Rigal (2) and Balzer (3) had previously observed degeneration of the elastic tissues which they interpreted as part of a xanthomatous process. Darier's (1) classic description of the clinical manifestations and pathologic findings have since been corroborated and augmented.

Pigment striae of the retina were first described by Pflange (4) in 1892. Some writers prefer to associate Doyne (5) with the initial characterization since he reported a case in 1889 in which an injury to both eyes produced angioid streaks of the retina. The term "angioid" was introduced in 1892 by Knapp (6) as descriptive of these streaks. It was not until 1929, however, that Grönblad (7) considered the syndrome to be one of focal disintegration of elastic tissues, localized usually in the skin and the retinae, but affecting also the elastic tissues in other parts of the body.

The occurrence of the skin condition with angioid streaks of the retina is quite common, but each may appear without the other (8, 9).

The cutaneous lesions of pseudoxanthoma elasticum usually develop as discrete, chamois-yellow papules or nodules, which later may assume a linear arrangement or merge to form plaques. As in most disturbances of the elastic tissue, the associated color change is usually some shade of yellow, which has been likened to the color of old piano keys. The papular elevations cause the skin to resemble closely that of a plucked chicken (11), or the skin has the stippled appearance of a lemon peel. In advanced cases, the flexural creases of the skin become lax, and pendulous reduplication of the natural folds is seen (Fig. 1 A, B, C, G). The disease usually starts on the neck or in the axillae, and while it may confine itself to these areas, similar changes have been noted in the folds of the groin, the knees and elbows. Milian (10) applied the term "cutis laxa" to this condition. Occasionally these lesions are found around the umbilicus, but the disease rarely involves the thighs, back, forearms and hands. Involve-

ment of the mucous membrane of the lips and gums was reported by Darier (1) and Ramel (15)

Subjective symptoms may be entirely absent The eruption may remain unnoticed until it is discovered accidentally through medical examination for some other cause, in some patients the symptoms are so mild that medical advice is never sought

Pseudoxanthoma elasticum may occur in any age group, and while it has been observed in infancy and old age, it is primarily a disease occurring from the age of puberty to young adult life, predominating in the female There is a familial history in some instances (11, 16, 17) However, Throne and Goodman (18), Ohno (19), and Gutman (20) have reported instances in which more than one member of the immediate family had the disease

COURSE AND TREATMENT

The course of the disease may be extremely slow and the condition may persist for months or years No successful method of treatment has ever been suggested, although some improvement has followed massage with ointments (9), superficial radiation (8), and the use of fibrolysin (17). Spontaneous involution of the lesions has been recorded in a patient who was pregnant (16)

Surgical intervention, except for biopsy, has not been reported although this skin disease was described a half century ago The results of the first operation performed for palliative reasons are illustrated in the case described in the present report.

CASE REPORT

A 35 year old white single woman was admitted to the Plastic Surgical Service of the Duke Hospital about 3 years ago When she was approximately 16 years old lesions had developed around the neck and in the axillae which were described as chamois yellow papules When the papules were first noticed they were discrete but the lesions later became confluent Many forms of conservative therapy had been tried without success There had never been any physical discomfort During the intervening years however reduplication of the normal folds of the neck and axillae had occurred The disfiguring lesions could be camouflaged during the winter months, but during the warm seasons they presented an harassing abnormality

Physical Examination Of especial interest was the purposeless reduplication of the skin folds of the neck and axillae (Fig 1) In these areas, there was almost complete loss of elasticity When the skin was drawn forward or stretched, it remained in that abnormal position until the head was turned or the arms were moved The texture resembled that of a chamois and the color was the characteristic yellowish tint A rolling contour was produced by the reduplicated folds with hills alternating with valleys In the skin of both the neck and the axillae, there were many small pits and crevices similar to those of a temple orange No induration was present, and even though the skin was thick, it was soft and chamois like The resiliency of the skin over the remainder of the body was normal These dermatologic findings and the diagnosis of this entity were verified by Dr J Lamar Callaway, professor of dermatology

The *ophthalmoscopic examinations* were made by Dr Banks Anderson, professor of ophthalmology Both eyes were normal externally, and the media were clear Vision was 20/20 in each eye The vascular bed in the right eye was normal, while the left retinal

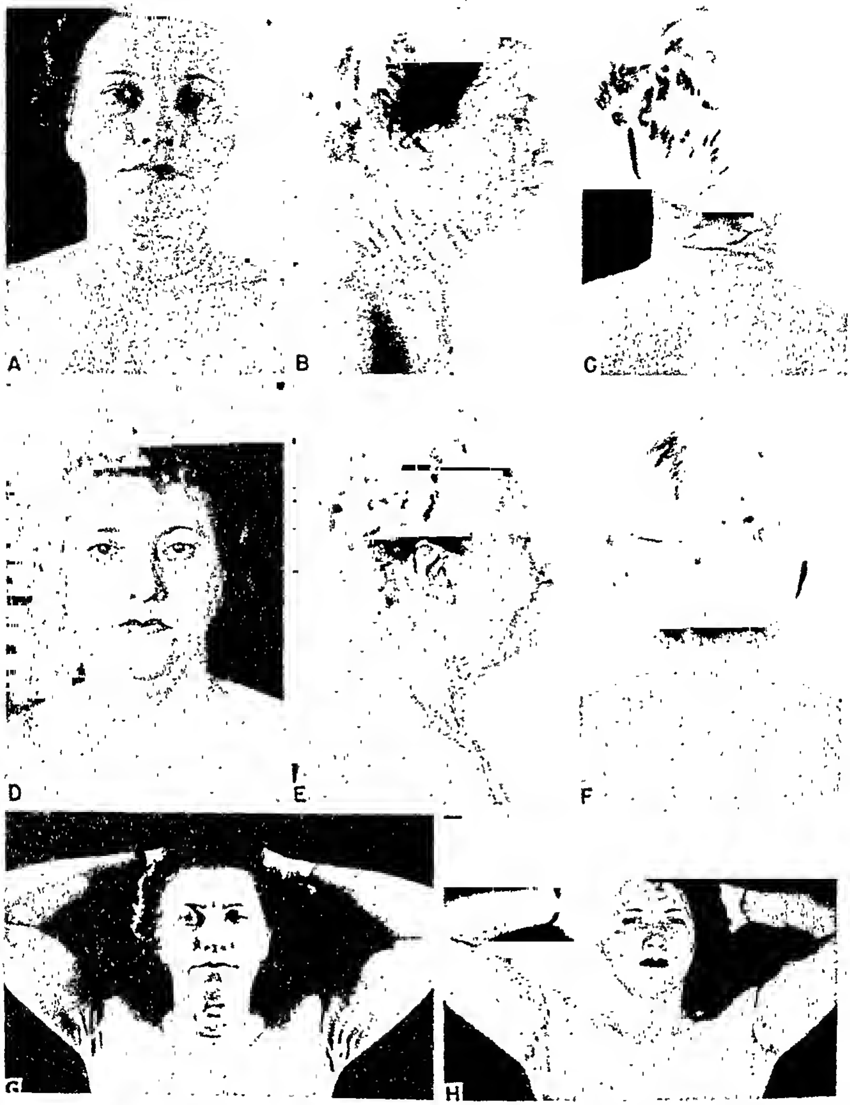

FIG. 1. A, B, C, G show the pendulous reduplication of the flexural folds of the neck and axillae, due to loss of elastic tissue. The deformity was a constant source of embarrassment and could only be camouflaged by wearing high neckline dresses. When the skin was stretched, between the fingers, the exaggerated folds remained unchanged for several moments. The color and texture of the skin was similar to a chamois.

The cosmetic deformity was corrected by undermining extensively the skin of the neck and axillae, and excising the redundant tissues. The operation was performed three years ago, with the result shown in D, E, F, H.

artery was anomalous and of increased caliber (Fig. 2). Otherwise, the fundi were similar and will be described as one. A dark angioid halo surrounded the disc and other dark angioid streaks radiated from it. A second important feature was the changes in the macula

where there was diffuse stippling with minute dull golden pin point discrete spots These were interspersed with dark more heavily pigmented flecks Temporal to the macula and extending upward to about 11 o'clock and downward to about 5 o'clock there were seen innumerable globular golden flecks These were discrete in the macular area, but at the periphery they became confluent so that here the retina assumed a dull golden color As far as we are aware, this latter feature of the syndrome has not been recorded previously

Laboratory Studies Detailed blood and chemical studies revealed no abnormal findings

FIG 2 A Normal skin B Histologic section, hematoxylineosin stain of skin excised from the anterior neck of our patient The microscopic changes in pseudoxanthoma elasticum are demonstrated There is complete disruption of the normal elastic tissue in
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Operation Excision of Redundant Skin of the Anterior Neck and Axillae The day prior to operation the approximate amount of skin to be removed from the neck and axillae was determined with the patient in the sitting position On October 18 1945 anesthesia was induced first with intravenous sodium pentothal and then maintained on endotracheal nitrous oxide oxygen ether The neck and axillae were prepared as sterile fields A low collar incision was made in a crevice of the lowest reduplicated cervical fold A gritty sensation was felt as the scalpel passed through the tissues On the cut surface of the skin there were numerous flecks of yellow material The skin flaps were mobilized superiorly to the hyoid and inferiorly to the clavicle There was almost complete absence of subcutaneous adipose tissue The mobilized flaps were overlapped with some tension the re

dundant tissues were excised, and closure of the opposing flaps was performed using interrupted sutures of fine white and black silk. It was difficult to insert a subcutaneous layer of sutures, chiefly because of the absence of areolar and adipose tissues, but in addition, because the corium was so friable that sutures would not hold. This may have been due, at least in part, to the almost complete absence of elastic tissue in the deeper layers of the skin. The redundant skin folds of the axillae were excised using oblique elliptical incisions, and here, too, difficulties were encountered when attempts were made to insert subcutaneous sutures. Nevertheless, primary healing occurred, and one-half of the cutaneous sutures of silk were removed on the third postoperative day and the remaining ones on the sixth postoperative day, when the patient was discharged.

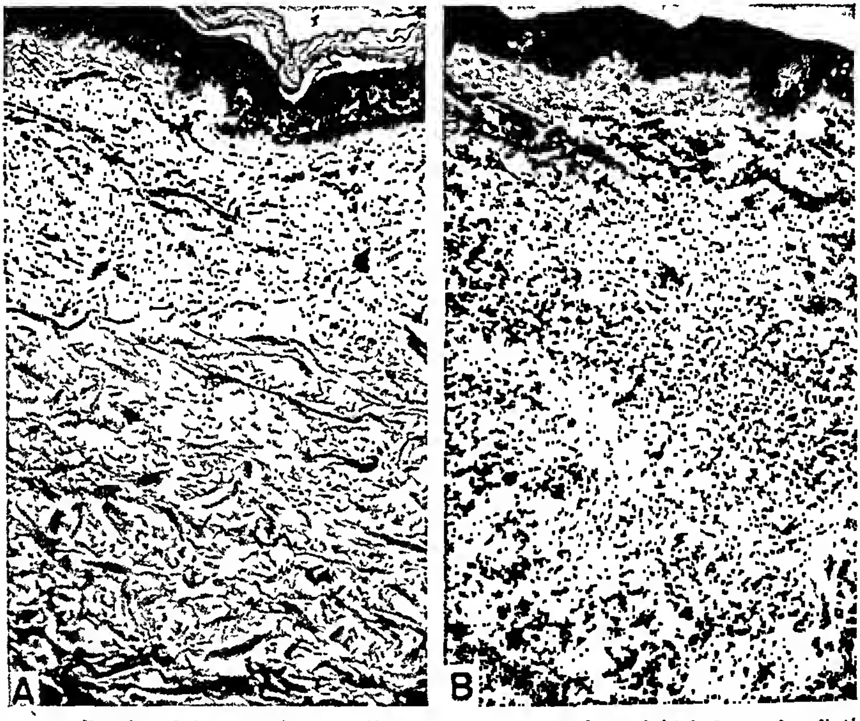

FIG. 3. Fundus, left eye. Surrounding the disc is a dark angioid halo, and radiating from it are additional angioid streaks. These visual findings frequently are associated with the cutaneous manifestations of the disease, and when present, comprise the syndrome—pseudoxanthoma elasticum, with angioid streaks. These streaks are not actually blood vessels *per se*, hence the designation—*angioid*.

About one month later, the patient was readmitted to our service, and the reduplicated folds on the posterior surface of the neck were excised by the same procedure as that used for removal of skin of the anterior neck and axillae.

Follow-up. The patient has been observed at intervals since discharge, and she has remained entirely well. There has been no evidence of recurring laxness of the tissues of the neck or axillae, nor have any changes taken place in other cutaneous areas (Figs. 1D, E, F, H). The ophthalmoscopic findings and visual acuity remain unchanged.

Histologic studies disclosed advanced degenerative changes in the elastic tissues, principally of the middle and deeper portions of the cutis. The delicate elastic fibers just beneath the normal epithelium were quite well preserved, while the deeper fibers were completely fragmented and granular in appearance (Fig. 3B). These elastic tissue changes

were not present however in the walls of the blood vessels There were in addition several areas of calcification which explained the gritty sensation on incision of the tissue Occasional giant cells were observed There were no accompanying changes in the collagen fibers although hyalinization changes were present in the underlying muscle There was no atrophy of the sebaceous or sudoriferous glands such as that seen in cutis senilis There was no appreciable inflammatory reaction in any of the tissues

Nomland and Klein (21) believe that the color of the skin in the affected areas is explainable by the peculiar degeneration of the elastic fibers together with the normal border zone between the degenerating fibers and the epidermis, resulting in the peculiar yellow tint This reaction may be comparable to that which occurs in a blue nevus—the lesion appears blue although the cells of the nevus are laden with melanin and not with hemosiderin

DISCUSSION

While the syndrome of pseudoxanthoma elasticum may be quite well known to the ophthalmologist and dermatologist, it is essentially unknown to the surgeon, primarily because reference to this disease entity has not appeared in the surgical literature prior to this writing The exact cause of the disease is obscure, but there is some evidence that heredity may play a prominent role Since the advanced stages of the disease are in some respects similar to the changes found in elastosis senilis, Jones and his associates (22) consider the condition one of presenility In the atrophic types of senile wrinkling the skin assumes a lusterless tinge of yellow, green, or brown The dry condition of the skin in this latter type of degenerative disease is due to atrophy of the sebaceous and sudoriferous glands Later the skin becomes thin, smooth, and glossy and the telangiectatic blood vessels can be readily seen beneath its surface In time, the skin assumes the appearance of dry, rumpled tissue paper with a loss of resiliency, owing to degeneration of the elastic fibrils, so that when it is picked up between the fingers the fold tends to remain

The cutaneous manifestations of pseudoxanthoma elasticum are not always associated with angioid streaks of the retina, for each may occur and develop independently (8) Kofler (23) considers the angioid streaks to be due to tears in the coat of the choroid or in the glass membrane resulting from the lack of elasticity of the membrane The streaks are thus optical phenomena similar to those manifest by a break in a glass If the break is over a choroidal vessel the color of the vessel is refracted through the break and is seen as a reddish streak and hence, the term *angioid* If the break is over the intervening choroidal tissue, the streaks assume a darker hue If these deductions are correct the pathologic process in the retina and the skin may be the same However, the exact cause remains unknown Since microscopic examination of the eyes in a patient with speudoxanthoma elasticum has not yet been recorded, the parallelism between the cutaneous and ocular lesions cannot be drawn conclusively

SUMMARY AND CONCLUSIONS

Prior to this communication, the surgical literature has lacked any reference to pseudoxanthoma elasticum The cutaneous sequelae of the disease need no

longer be disfiguring and a constant source of embarrassment. By the application of simple plastic surgical procedures the deformity can be removed, as was the case with the patient here presented—apparently the first individual to receive surgical treatment for this disease.

Pseudoxanthoma elasticum and angioid streaks may be associated, and present a definite syndrome. Frequently, however, they occur independently of each other. The cutaneous manifestations of the disease are harmless except for the cosmetic disfigurement, whereas the angioid streaks are frequently followed by or associated with varying degrees of choroiditis, and thus may offer a more serious prognosis.

The etiology of both the cutaneous and retinal manifestations of the disease remains unknown, although the most plausible explanation is that both result from degenerative changes in the elastic tissue.

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HETEROPLASTIC AND ISOPLASTIC SKIN GRAFTS*

With Report of Successful Repair by Isografts, of Bilateral Ectropion of Four Eyelids, due to Ichthyosis Congenita

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The history of heteroplastic and of isoplastic skin grafts has been interesting if for no other reason than for the casualness with which it has been considered One author stated in his text-book, that the graft should, if possible come from the person to be grafted, and in another text book the statement appears "that grafts may come from another person, or from a lower animal but such grafts are not so apt to grow as grafts obtained from the individual and even when they do grow, fail to furnish a secure cicatrix" The use of such grafts has proved to be wishful thinking rather than sound surgical technique The odd and unusual organic membranes which have been used from time to time if successful, could have achieved success only by acting as a temporary protective membrane, while true epithelization occurred over a defect from the individual's contiguous epithelium by extension beneath such a protective membrane

It is rather delightful to read in Da Costa's Modern Surgery" a late edition, the statement that "frog skin furnishes an unsatisfactory graft" In spite of this, the skin of rabbits, of guinea pigs and of puppies the lining membrane of a hen's egg and small bits of epidermis taken from a recently amputated leg have been used at various times Defects in the mucous membrane of the globe and the lids of the eye, as well as the surface epithelial defects have all been subjected to these physiologically unsounded procedures at various times

Heretoplastic grafts of live cartilage and of live bone, of formalized cadaver cartilage, of pickled fascia, and of formalized beef and veal cartilage, are not grafts, in the true sense These also are bridges pegs, or supports in which a slow form of acual tissue necrosis occurs, (certainly some form of tissue death), but simultaneous to this change (and subsequent to it as well) there occurs fibrosis, and even calcification in these structures This appears as a foreign body tissue response from the recipient's tissues and because of it there develops a satisfactory corrective fixation of such grafts

The successes reported at various times with the use of amniotic membrane as a conjunctival replacement graft, even when experimental, must also be of this bridging type or mechanism One can be properly unwilling to consider it otherwise until microscopic demonstration of such a successful graft has been presented to the profession

This sequence of events and the biological process entailed are quite different from that response which is anticipated from a surface graft as is epithelium (or mucous membrane), split through its thickness or of full thickness Actually

* Presented before Section of Ophthalmology, Philadelphia College of Physicians April 22 1948

one can liken the process of recovery from heteroplastic or isoplastic cartilage and/or bone to that seen in a tantalum implant for correcting a bony defect, as for instance of the supraorbital ridge. The only real difference, with the tantalum implant, is the failure of penetration of the recipient's connective tissues into the tantalum. They cannot penetrate the texture of that implant as they do bone and cartilage. The tantalum remains in place because of fixation, by the lack of irritation, and with this some encapsulation, which is further fixation.

Epithelium, when applied as a graft to the surface of a defect, must grow there, if it is to remain permanently, and become an integral part of the recipients' anatomy. The general surgeon's comments about the success of isoplastic skin grafts are unfortunately contradictory. These range from, "being of no value", and "they aren't especially satisfactory, and certainly not as satisfactory as pinch grafts which are cut from the individual's own intact skin", to, "of only temporary and transient value, but as that of value under various circumstances".

The cause for this lack of success in isoplastic grafts is not clear. When blood type matching was developed donors and recipients were usually matched to the same blood type, and for a while there seemed to be more successful 'takes'. This optimism lasted only a short time for failures seemed to be as constant. The M and N factors in the blood streams and with, or because of them, the more recent determination of the large number of blood types which seem to exist, are perhaps of greatest importance. The matching of the Rh factor between recipient and donor has not been done, as yet, by any invetigator in considering success or failures with isoplastic grafts.

The patient upon whom this presentation is based was one with bilateral ectropion of the four lids due to Ichthyosis Congenita. The latter condition is a rare dermatosis which either may be present at birth or may not become manifest for some weeks or months after birth. The etiology is unknown and the hereditary factor as studied by Cockayne points out the high rate of consanguinity in a study of 188 cases. The condition is recessive and occurs more frequently in males.

There is some confusion in the Dermatological literature as to both nomenclature and classification based on clinical types. The chief clinical characteristic of the disease is a hyperkeratosis of the skin, varying in degree and distribution. Ectropion does not necessarily occur in Ichthyosis Congenita. McKee and Rosen in their comprehensive study of Ichthyosiform Erythroderma analysed 45 cases that were published in the French Literature. Of the cases reviewed, 16 had facial involvement and 7 were mentioned to be suffering with ectropion. Corneal involvement and blindness are mentioned in the case reports, but the data were insufficient to determine whether this was a result of ectropion or due to some other cause. In the German literature Sonderman in 1923 described a case of ectropion complicating Ichthyosis Congenita and resulting in a perforating corneal ulcer.

The presence or absence of ectropion in Ichthyosis Congenita as demonstrated in cases reported in the literature depends on the following three factors. First, whether there is involvement of the face; second, whether atrophy of the skin

occurs, third, the severity of the atrophy of the skin The skin of the eyelids retracts along with the skin of the face thus everting the lid margins On this basis there can be bilateral involvement of both upper and lower lids The occurrence of "four lid ectropion" is extremely rare occurring only in severe cases of Ichthyosis Congenita the patient usually dying in the first year

Shimkin in 1945 records one such case and mentioned that no cases had been recorded in a review of the British literature since 1916 The French literature reported one case in 1939 and the German literature mentioned Sonderman's case in 1923 and Elschnig's case The latter (Elschnig) reported that in 1912 he performed a plastic graft in a patient 9 years of age with "four lid ectropion" caused by Ichthyosis, the graft being taken from the forearm of the patient's older sister Eleven years later Ichthyosis developed in the implant but the function of closing the eyelids remained good

Two rare cases of successful isoplastic surgery of the eyelids were reported by Shimkin in 1945 in the British Journal of Ophthalmology His first, a case of post-trachomatous trichiasis in a hemophilic youth was treated by a graft from the buccal mucous membrane of his father The second case a baby of 13 months, suffering with generalized congenital ichthyosis, was treated with whole skin grafts from the forearm of his mother Implants were placed in three lids, excepting the lower left lid The isografts were reported as being successful with a restoration of function of the eyelids The latter case was also reported by Shimkin in 1945 in Harfuah, a Jewish Medical Journal

CASE REPORT

The patient being presented is a 15 year old white boy admitted to Wills Hospital December 10, 1947

He was an only child and there was no history of abnormalities of the skin in either side of the family

Two weeks after his birth, a red rash appeared over the entire body and this was soon followed by a generalized scaly condition of the skin The diagnosis of Ichthyosis Congenita was established as a child and he was presented by Dr John Ludy to a Dermatologic Convention

Epiphora started about the age of 8 and ectropion of the lids was rather severe at the age of 10 About 4 years previously the patient had been treated for 1½ years for a corneal ulcer of the left eye For 2 months prior to admission the patient was treated as an outpatient for a corneal ulcer of the left eye with no benefit

On general examination, the entire body of the patient was covered with brownish scales The palms of the hands and the plantar surfaces of the feet were blackish in color and were deeply fissured The skin of the face was taut and there was severe ectropion of both lower lids with a slight ectropion of both upper lids

Considerable photophobia and marked epiphora were present The slit lamp showed the right cornea to be clear while the cornea of the left eye showed some scarring just below pupillary area and an active ulcerative keratitis on the temporal side

It was obvious that to correct the ectropion which was the basic cause of the exposure keratitis a skin graft would be necessary But as the skin of the whole body was abnormal and no members of the family were available a skin donor was suggested

Up to the present the authors' experience with heteroplastic and isoplastic skin grafts had been one of universal failure In no instance did a graft take well at the start and remain in place for any length of time without complete subsequent lysis even necrosis, of

the graft and a final failure Isoplastic corneal grafts have a rather indefinite position midway between grafts which act only as a bridge for subsequent epithelization or cicatriza-

FIG 1 CASE OF ICHTHYOSIS CONGENITA

All four lids in ectropion The ointment which patient has been using constantly is ommitted in this illustration to show the texture and appearance of the skin of the face The skin of his entire body was similar

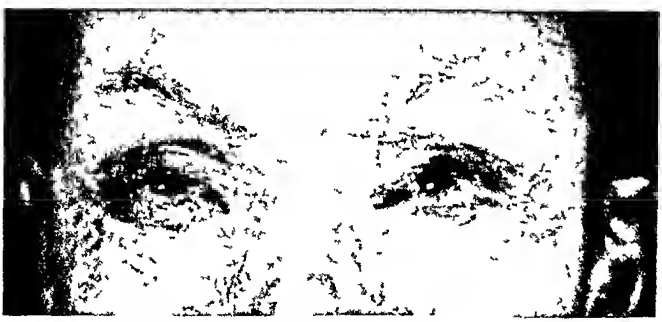

FIG 2. Intermarginal adhesions, postoperative following surgery. It was planned to retain these unchanged for a period of six months.

tion and grafts which become an integral part of the recipient's anatomy A corneal graft is avascular and because of its rather low metabolic and nutritional demands can remain

viable. It is remarkable that so many remain transparent. Even so, one can see, repeatedly, a reaction in the recipient's eye, to such grafts, which can properly be called a foreign body reaction as demonstrated by cicatrization of the graft, vascular infiltration, and

Fig 3. Exact schematic drawing showing, from a tracing, the size and position of the correcting skin grafts as they lay, following surgery. The grafts are difficult to see in Figure 2 See Figure 4.

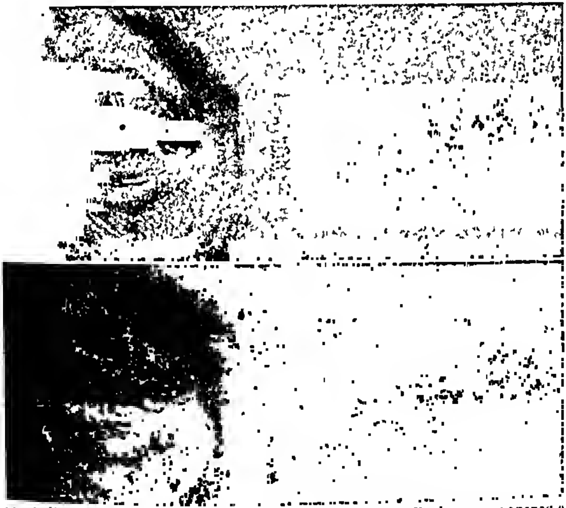

Fig. 4. End result following sectioning of the intermarginal adhesions, eyes opened and closed

opacification of the graft. Certainly in corneal grafts one has never been too concerned as to blood or Rh matching in donor and in recipient.

In this case the contraction of the child's lower lids was of such a degree, and the texture of the skin of such a type that any other surgical procedure for the correction of the ectro-

pion was doomed to failure. The condition which he had was due, essentially, to a lo: epithelium, i.e., an insufficient amount of epithelial covering of the lids because of contraction from his skin disease. Cautery punctures, tarsectomy, and any type of sur to the orbicularis fibers could not have helped the case, and for that reason isoplastic gr were considered necessary.

It was some time before a donor was obtained who matched in blood type, Rh factor, M and N blood factors for it was thought wise that these all should match before a don epithelium could be used as an isograft.

On January 18, 1948 a median tarsorrhaphy was performed. A linear incision was m parallel to the lid margin and the skin was freed on either side. A razor cut free skin gr taken from the donor's thigh, was fitted into the area which had been prepared with thr boplastin solution. The lids were then covered with oiled silk and a firm pressure banc applied. The first dressing was done 10 days later and the isograft was found to be herent, pink, and free of discharge.

About twenty days later, a similar operation was performed to the right eyelids using same donor. Ten days later at the first dressing, the graft was found to be adherent, p and healthy.

It is quite impossible to say that this careful preoperative planning was the reason the successful takes. An equally likely conjecture is that the success, in these two sepa operations, done at an interval of four weeks, in this individual, were: (1) because of very thin grafts which were obtained from the donor; (2) the absolute hemostasis wh was obtained in the graft site; (3) the close approximation obtained with graft to unde ing orbicularis fibers, through the thromboplastin shellac which was used, plus; (4) meticulous cross matching which was done between donor and recipient. The time wh has intervened since the surgery and the present presentation is sufficiently long now t one may expect this surgical result to be permanent.

SUMMARY AND CONCLUSIONS

The case has been presented without any recommendations for preoperat planning for future similar cases. These cannot be made because there is certain basis upon which such recommendations could be made. The surgi principles mentioned are neither new or unknown.

In conclusion we were unable to find a similar case of successful isografts ectropion resulting from Ichthyosis Congenita, in the American Literature.

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THE USE OF ESSENTIAL FORMS IN GENERAL PLASTIC SURGERY

ROBERT C. SEELEY

The recent advances in general plastic surgery have been made by the promulgation of standard technics through the use of books, periodicals, photographs, motion pictures, drawings and exhibition of patients as well as through teaching clinics.

It is an accepted principle to photograph every patient subjected to plastic surgery. The lesion, pathology or deformity must naturally be shown on the photograph.

To continue the advance and teaching of plastic surgery photographs must of necessity be exhibited, particularly to professional groups. To many patients, this is objectionable. However, when the purpose of the photograph is properly explained, in most cases permission for their use can be obtained. The proper time to secure authorization for the use of photographs or other scientific data from the patient is during the preoperative stage. When the postoperative stage permit is requested the patient is already accustomed to the routine.

With this idea in mind, the writer has devised a form of authorization for scientific purposes as per figure RS Form No. 1 (Fig. 1). This form is to grant permission to use photographs, casts, models or motion pictures in connection with scientific demonstrations.

To insure proper identification and authorization of negatives and photographs the writer has devised Permit Forms Nos. 10 and 11 (Figs. 2 & 3). RS Form No. 10 is representative of a pre-operative photograph permit as signed by the patient and witnessed by the photographer with the date of the photograph. RS Form No. 11 is representative of a postoperative photograph permit as signed by the patient and witnessed by the photographer with the date of the postoperative photograph. These cards are part of the negative. The patient holds the card visible to the camera and just below the photographed field. This is an absolute method of protecting the surgeon against the denial of the character of the situation preoperatively. The authorization and photographer's signature can be masked out of the print.

It is also deemed advisable to secure a separate consent for operation. In many hospitals consent for operation from private patients is not demanded on admission. It, therefore, becomes necessary for the doctor to have his own forms for operative consent. Reference to RS Form No. 15 (Fig. 4) shows a clear cut authorization for operation and is usually witnessed by the secretary or nurse.

CONCLUSIONS

The writer has presented a series of printed forms which he deems of value in the practice of General Plastic Surgery. While these forms are particularly of value to those doing plastic surgery about the face and neck, they can be em-

R. S. FORM 15 1947

CONSENT FOR OPERATION

given to

. . . .
NAME OF DOCTOR

Date . . . .

I, ... hereby give consent to
Name of person giving consent

Doctor . . . .
Name of Doctor or Surgeon

to perform the operation known as

. . . .
Name of Operation

or any modification of such operation on myself or my minor or ward,

. . . .
Relationship and name of minor

as may be deemed necessary by Doctor . . . .
Name of Doctor

Signed . . . .

Witnessed:

. . . .

. . . .

Fig. 4

ployed in general plastic surgery as is the practice of the writer. It is hoped that many readers will find these forms of value in their routine work.

RS Form No. 1 is perhaps most important for those who write or teach.

RS Form No. 10 and No. 11 is a proof positive method of dating negatives and photographs, carrying as it does signatures of patient or guardian and witness.

SQUAMOUS CELL CARCINOMA DEVELOPMENT ON DONOR AREA FOLLOWING REMOVAL OF A SPLIT THICKNESS SKIN GRAFT

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It is the author's belief that this is probably the only case on record in which a squamous cell carcinoma has developed in the area from which a split thickness graft was obtained for grafting. A thorough search has been made by the author through numerous publications and textbooks with regard to this type of carcinomatous development, but no reports of even one case was found in the literature. However, there are numerous cases reported of squamous-celled cancer on scars from old burns, whether from electrical currents or irradiation, chemicals or heat, and are especially prone to become ulcerous and even malignant. If, however, more specific knowledge has already been presented and eluded the author's search, apologies are made for such.

This case was observed and treated in one of the army plastic and maxillofacial surgical centers* in the zone of the interior where a tremendous quantity of plastic work was being done during the second world war, and for almost two years following cessation of hostilities.

CASE REPORT

The patient was a 29 year old, white, well developed, male officer who was admitted to the hospital on February 20th, 1945 for plastic reconstruction of a cicatricial contracture of the web between the little finger and the ring finger of the left hand. This cicatrix was the end result of a laceration which was accidentally incurred in a jeep accident on Sept. 23, 1944 while this patient was serving overseas.

His physical examination was essentially negative except for a 3 cm. scar extending on to the dorsal and volar surfaces of the left hand between the ring and little fingers. The patient also had a neurological impairment of sensation along the radial border of the little finger and the ulnar border of the ring finger. His past history and family history were negative for cancer and faulty epithelial proliferation. On March 14, 1945 plastic reconstruction of the web between the little and ring fingers of the left hand and a neurolysis of the ulnar digital nerve was performed under pentothal sodium anesthesia. A split thickness graft was taken by means of a Padgett's dermatone from the left thigh, medial aspect and placed into the web between the little and ring fingers of the left hand following surgical excision of the scar tissue. The graft took very well and the hand continued to improve normally without any complications.

There was, however, delayed healing of a small area at the donor site on the left thigh, which in spite of the usual pressure dressings, continued to granulate and break down. In the month of May, 1945, the donor area appeared to have healed completely. The patient was given a prolonged sick leave because of the nerve injury, but returned back to the hospital early in August, 1945 because the donor site had broken down with subsequent development of hard subcutaneous nodules attached to the skin over the donor site. A biopsy was obtained from the raised but broken down granulated area of the donor site of the left thigh. The report on this biopsy study was that of a squamous cell carcinoma and which was substantiated by two other laboratories.

* From the Dept. of Plastic Surgery, O'Reilly General Hospital, Springfield, Missouri.

FIG. 1. LEFT THIGH FROM WHICH SKIN GRAFT WAS TAKEN SHOWING SQUAMOUS CELL CARCINOMA

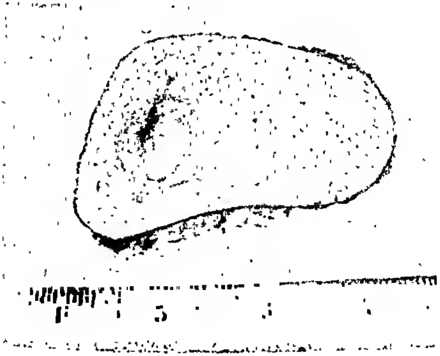


FIG. 2. TUMOR MASS AFTER EXCISION

Fig. 3. High Power Photomicrograph. Section from Skin of Donor Area
There is invasion of the corium by islands of tumor cells of squamous and prickle cell type. Epithelial pearl formation is present.

Fig. 4. Appearance of Split Graft from which Tumor was Removed. Well-healed at the End of 3 Weeks

A radical excision of the tumor mass with some apparently normal healthy tissue was performed and a split thickness graft was obtained from the patient's right thigh to cover the defect Both donor site and skin graft areas healed without any further complications

Our pathologist (Major G D Ayer Jr) described the excised specimen and his comment in part, upon the gross and microscopic picture is as follows

Gross— the specimen consists of a roughly oval piece of skin and underlying fatty tissue measuring 8 0 x 4 9 x 1 6 cm 1 5 cm from one end and 1 3 cm from one margin is a white nodular elevation measuring 1 8 x 1 2 cm It is elevated 0 5 cm above the surface On section the epithelium here is elevated by a nodular white tissue 0 3 cm thick different in appearance from the grey corium elsewhere

Microscopic—' the sections (3) are covered on one surface by stratified squamous epithelium The described central tumor consists of irregular down growth and thickening of the rete pegs and islands of epithelial cells well keratinized The basal layer in many places has lost its polarity and cells are irregularly invading the surrounding tissue The growth has not reached the base or the margin of the specimen

This case has been followed for a period of over two years with no incidence or recurrence The graft is soft pliable and of excellent quality This case is being presented with the thought of stimulating surgeons to look for such unusual development of cancer, particularly in donor areas which fail to heal within the normal period Repeated breakdown of donor areas should be investigated and biopsied and studied microscopically to definitely rule out malignant lesions from inflammatory reactions of tissues Care should be given to the donor areas as well as to the graft itself in all cases

SUMMARY

A case of squamous cell carcinoma was presented which developed in an unusual way and in a short period of less than six months following the cutting of a skin graft from the left thigh The etiology of its development could not be ascertained, for the usual course of post operative treatment was followed which consisted of moderate pressure dressing and boric acid gauze directly over the donor site There was no evidence of friction or infection and the patient had a normal temperature throughout his entire convalescence Diligent and thorough investigation of medical literature has been carried out to find out if similar cases have been reported However, no such case was reported in the literature

Soon after birth the area of membranous defect began to necrose, and by the end of the third week the entire area showed a condition of dry gangrene (See Figs. 1 and 2). It was hoped, however, that epithelization might be progressing satisfactorily under the crust, and on 1/17/47, nearly 4 weeks after birth, the baby was discharged from the hospital with no advice as to treatment except to continue with soft, protective dressings to the lesion. During hospitalization weight gain had been satisfactory.

On 2/15/47, 4 weeks after discharge, the baby was readmitted with a history of sudden severe hemorrhage from under the scar apparently from the sagittal sinus and controlled only by firm pressure. After a week in the hospital with no further hemorrhage the baby was again discharged.

FIGS. 1 and 2. Appearance of scalp defect at end of third week after birth. Area shows dry gangrene of membrane.

A third admission, 3/5/47 to 3/8/47, followed a similar episode of hemorrhage and on 3/23/47 the fourth and fatal one occurred.

Necropsy was performed by Dr. Wm. G. Berhard, with the following positive findings:

A. GROSS PATHOLOGY

1. *Congenital ectodermal defect of the scalp.*
   There is a very dark reddish necrotic area over the regions of the anterior-posterior fontanelles and sagittal suture between them, which is ulcerated at the center and through which a probe can be directed into the superior sagittal sinus.
2. *Cranioschisis*
3. *Congenital heart disease*
   Persistent truncus arteriosus, four-chambered heart with hypoplasia of the right ventricle, absence of the tricuspid valve opening hypertrophy of the left ventricle and of the heart, patent foramen ovale, defect of the interventricular septum at the upper end near the aortic valve.
4. *Congestion of the spleen and hematopoietic tissues.*
5. *Edema and congestion of brain with chronic inflammatory changes and edema of the pia arachnoid.*

B. MICROSCOPIC PATHOLOGY

The superior surface of the ulcerated area of the scalp consists of blue, deep-staining necrotic and degenerated material which is infiltrated by numerous inflammatory cells. Beneath this there is a thick fibrous septum which has undergone hyaline degeneration and is infiltrated with inflammatory cells. In this fibrous area parts of the large vein in the sagittal sinus can be found.

C MICROSCOPIC DIAGNOSIS

Necrosis and acute and chronic inflammatory changes and ulceration of the skin from the scalp

D CAUSES OF DEATH

Hemorrhage due to rupture of the sagittal sinus

COMMENT

Death from hemorrhage or from hemorrhage with meningitis has occurred in four cases of congenital scalp defect in a manner almost identical to that in ours (12, 11, 2, 19) In all of the cases the lesion was of the membranous type, relatively large, and lay over the superior sagittal sinus The sequence of events was as follows first, a dry gangrene of the membrane characterized by blackening and mummification, then, detachment at the edges followed by bleeding and death Usually, tho not always, there were several preliminary hemorrhages before the final one In one case (12), death occurred with the first hemorrhage and on the eighth day after birth, in another (11), the first hemorrhage occurred on the twenty-first day and the fatal one on the twenty sixth, in the third (2), the first hemorrhage took place after four weeks and death from meningitis at the end of the second month, and in the fourth (10), the first hemorrhage occurred 15 days after birth and the final one 30 hours later

The defects varied from "the size of a crown piece" (12) to a 6 x 7 centimeter irregular defect as in Pincherly's case (11) In Heidler s (2) the defect was 2 2 x 5 centimers, and in Moller's (19), 6 x 8½ centimeters When the defects are small, even tho they lie over the superior sagittal sinus hemorrhage is not apt to occur In Dowler's case (14), for example, the lesion which extended longitudinally over the whole vault of the cranium and was 1 5 to 2 centimeters wide, healed without necrosis In Burger's case (13) an S shaped defect over the posterior fontanelle, originally 2 to 3 millimeters in width, healed in spite of necrosis Apparently even a large membranous defect such as reported by Cole et al (5) which measured 6 x 8 centimeters, if it is not over a suture line or associated with a skull defect will not become gangrenous

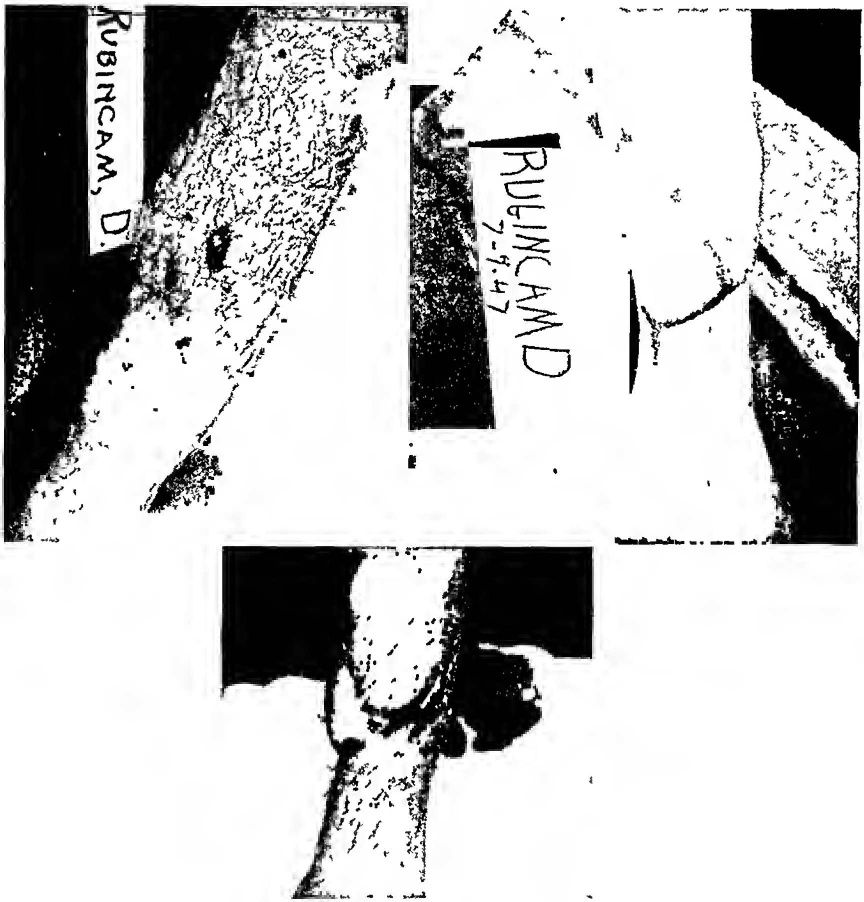
This means that in cases of congenital defect of the scalp, if the lesion is larger than, say, 1 or 2 centimeters in width and lies over a widened suture line, it may become necrotic If the superior sagittal sinus is exposed by detachment of the crust, a fatal hemorrhage is likely to follow In such cases watchful waiting is apparently a dangerous plan, and an attempt to cover the defect with normal skin should be made at the earliest possible time Scalp flaps could be swung or slid from the surrounding normal tissues as best suited the shape of the lesion Resulting defects could be split grafted at the same or a later date with only the anticipation of a bald spot instead of a probably fatal hemorrhage

What happens to a membrane which is left intact over the sagittal sinus or over an area of suture separation when it is buried, is not known, and the problem remains as to whether it would be better to merely clean it and leave it alone, or to attempt to peel it off and create a raw surface The latter step would seem both difficult and hazardous due to the thinness of the membrane

There is one last point to be brought up and that is the question of what to do

decided upon, and on Sept. 27, 1946, formation of the tube was carried out, with stage transfer being completed by February 24, 1947 The time consumed here, was longer than usual because extra stages were required in waltzing one end of the tube into position to cover the scar on the medial side of the leg.

a b



c

FIG. 1(a). Pre-operative photograph showing the anterior leg scar, overlying the tibial fracture site. Two areas of recurrent ulceration are present. An equally large scarred area is present medially, but its presence is only suggested in this view by the depression appearing on the medial side of the leg

FIG. 1(b). Postoperative photograph showing both scars replaced by the pedicle. Photograph taken in July, 1947, when patient returned for revision of the pedicle.

FIG. 1(c). Follow up photograph taken at the time of the last X-ray in February of 1948.

X-rays (Fig. 2 b–f) following the application of the pedicle have shown gradually increasing callus formation. Firm clinical union was present by July of 1947. The patient was ambulated at this time with a brace, wearing a shoe with a lift to compensate for an inch shortening. X-rays, the last in February of 1948, have shown good bony union. At the last examination, the patient was allowed to discard the brace. The patient had no complaints. Post-operative photographs are shown in Fig. 1(b) and (c).

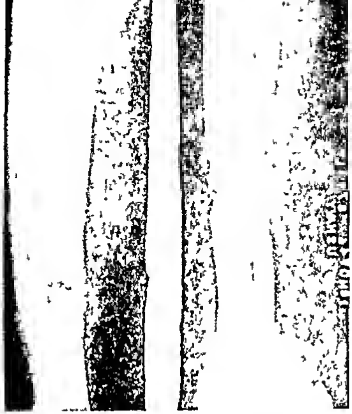


Fig. 2(a). X-ray taken fourteen months after injury showing the persistent non union of the tibia. Pedicle replacement of the anterior scar was carried out two days later.

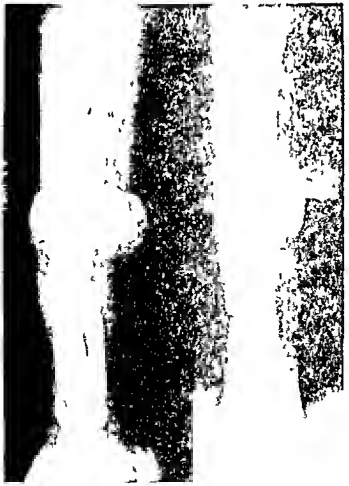
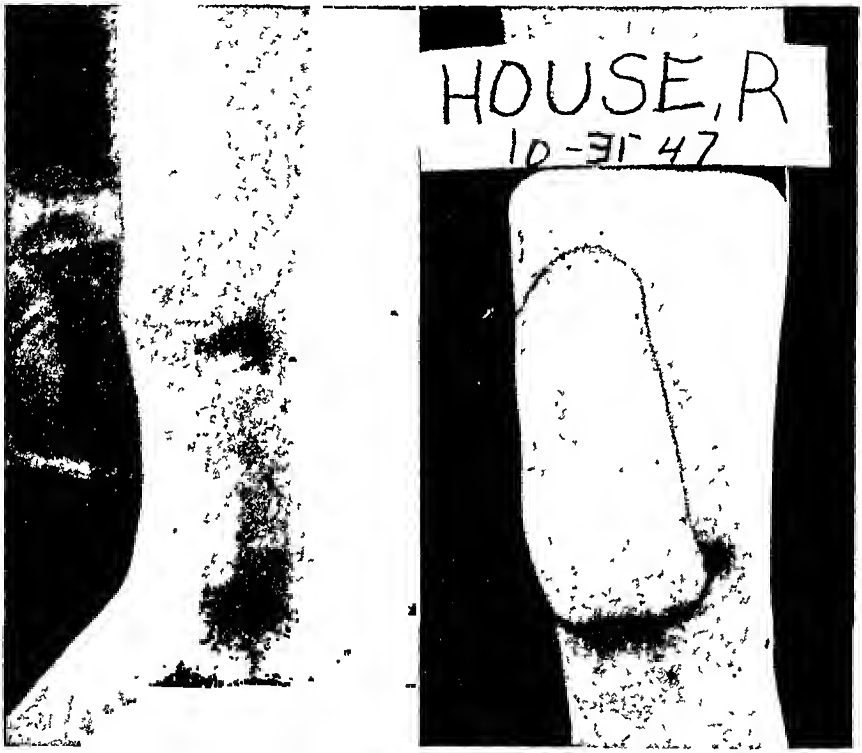


Fig 2(b). X-ray taken … about seven weeks after elimination of the … he transverse … icle still tubed … provement in the non union can already be noted

CASE II

A twenty-two year old white male was injured in combat in April of 1945. He sustained a severe compound fracture of the right leg, with transverse fracture through the lower tibia and a fracture through the mid shaft of the fibula. Emergency care and splint immobilization were completed within two hours of injury, and within twenty-four hours, he had been transferred to a hospital ship, where cast immobilization was instituted. Drainage persisted at the fracture site and an osteomyelitis of the tibia developed, which caused persistent drainage till March of 1946. At this time, sequestrectomy was performed and



a b

Fig. 3(a). Preoperative photograph showing the extensive scar overlying and bound down to the tibia in the region of the fracture.
Fig. 3(b). Postoperative photograph showing the pedicle replacement of the scar tissue.

although this was followed by improvement in the bone infection, the non-union of the tibia persisted.

Following cessation of drainage, in April of 1946, one year following injury, the patient was fitted with a walking cast, but a trial of several months ambulation in this manner failed to bring about union. The patient was then transferred to this activity for bone grafting.

In May of 1947, over two years following initial injury, this man was received for pedicle coverage, prior to bone surgery. Examination at this time revealed a large dense, bound down scar, Fig. 3(a) on the anterio-medial aspect of the right leg, overlying the tibial fracture site. Clinical non-union of the tibia was evident, and X-ray (Fig. 4(a)) showed non-union, with eburnation of the fracture fragments.

On May 5, 1947, surgery was begun and after several delays of a large cross calf pedicle,

a

b

Fig 4(a) (b) Preoperative X rays taken on February 21 1917 and April 2, 1947, two years after injury, showing the persistent non union

FIG. 4(c). Postoperative X-ray taken on September 17, 1947, about seven weeks following initial attachment of the pedicle to region of fracture. One month following this, firm clinical union was present and walking without a brace was allowed at this time. The marked improvement is evident from comparison with Fig. 4(a) and (b).

FIG. 4(d). Follow-up film sh·
at this time.

final transfer of the pedicle was completed on August 18, 1947 Ambulation on crutches was allowed on August 30, 1947 X rays Fig 4(b) (c) (d), subsequent to the application of the pedicle have shown rapid healing of the fracture site By October 10, 1947, there was strong union clinically, with no tenderness at the fracture site Full weight bearing was begun at this time, without a brace A postoperative photograph taken at about this time is shown in Fig 3(b) A follow up examination was made in January of 1948 when a re-check X ray was taken This showed further evidence of healing, and the patient had been symptom free since discharge and carrying on full activity

CASE III

A forty year old white male was injured on February 13, 1944, when the automobile in which he was riding, was struck by a train Several other occupants of the car were killed, but this man emerged, the lone survivor He was immediately taken to a hospital near the scene of the accident Examination revealed the patient to be in deep shock and coma The fourth and fifth ribs on the right were fractured, with puncture of the right lung producing hemoptysis and emphysema of the thoraco abdominal wall Fractures of the upper ends of the right tibia and fibula were present, with the tibial fracture involving the knee joint Intracranial damage was also present

Shock responded to treatment, the hemoptysis cleared in a few days, and consciousness returned on the fourth day The patient's mental condition gradually improved subsequently A pinning of the os calcis and immobilization of the leg in a Thomas splint was carried out on the second day

On February 23, 1944, ten days after injury, the patient was sufficiently improved for transfer to a nearby Naval Hospital The leg was immobilized in a plaster cast and systemic treatment was continued Examination revealed the additional finding of a tibial and peroneal nerve paralysis on the right, thought to be due to crushing, rather than section On June 6, 1944, a neurolysis of these nerves was carried out, the nerves being intact, and subsequent recovery of function ensued

X rays revealed little callus formation at the fracture site, and on September 11, 1944, seven months after injury, an open reduction was done and two screws were placed in the tibia Drainage appeared at the operative site and an osteomyelitis developed Several sequestra were removed over a long period of time and considerable soft tissue loss resulted from the infection Cast immobilization was continued during this time, and finally in September of 1945, the drainage ceased entirely X ray at this time revealed no evidence of union

In preparation for a bone graft, better coverage of the area was required, and in stages an adjacent pedicle of the leg was rotated to cover the fracture site, being completed on May 2, 1946, about 27 months after injury

On June 21 1946, a lower tibiofibular arthrodesis was performed and on July 15, 1946, an upper tibiofibular arthrodesis was carried out In November of 1946, a bone graft was performed at the tibial fracture site, but this was unsuccessful Because of the long persistence of the fracture and the repeated failures of attempts to bring about union the patient was transferred to this activity for amputation

Examination of the patient at this time showed no clinical evidence of union of the fracture of the upper end of the right tibia A large bound down scar, with extensive ulceration, was present on the upper anterior surface of the right leg Fig 5(a), overlying the fracture site X ray Fig 6(a) revealed no evidence of union

An attempt to save the leg was decided upon, and on April 12, 1947, thirty eight months after initial injury, the patient was received on the Plastic Surgical Service for replacement of the scar and ulcer, prior to bone grafting On April 12, 1947, an abdominal tube was begun and replacement of the leg scar was completed by September 21, 1947 A longer time than usual to effect the transfer was required, because the first attachment of the tube to the leg was unsuccessful and re attachment had to be carried out X rays 6(b) and (c) subsequent to pedicle application, have shown very rapid progress of callus forma

a b

FIG. 5(a). Preoperative photograph taken about three years after injury, showing the extensive scar with ulceration.

FIG. 5(b). Postoperative photograph taken at time of a follow-up visit, showing the great improvement in the soft tissues.

FIG. 6(a). Preoperative X-ray taken on March 10, 1947, over thirty-seven months after injury, showing the long standing non-union.

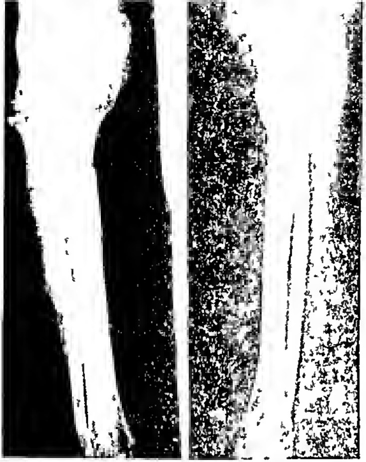


Fig 6(b) Postoperative X ray taken in October of 1947, about two and one half months after elimination of the leg scar was begun The marked improvement in the long standing non union is clearly shown

Fig 6c() Follow up film showing subsequent improvement Condition of the pedicle excellent at this examination

RHINOPHYMA

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Rhinophyma is a hypertrophy of the lower half of the nose which may or may not involve the lower half of the alar rim. It is the sequel of the final stage of acne rosacea. A tough, purplish, reddened, lobular and scarred skin is noted. In many examples of the deformity there are pits and fissures. The condition is slowly progressive and almost exclusively confined to men, appearing about the middle span of life.

The persistent hyperemia in the early stages causes a permanent dilatation of the arterioles, venules and capillaries with a consequent proliferation of new blood vessels, abnormal formation of connective tissue, and in the course of time, hypertrophy of the sebaceous glands in the form of lobulated masses. These become dilated, being transformed into cysts containing a large amount of sebum. The secretion finally burrows its way to the skin surface. The deeper tissues *also show scarring and infiltration of lymphoid and plasma cells and leucocytes,* with a yellowish pigment content.

The disease often involves the nasal bones causing osteitis and enlargement of the nasal width. It becomes necessary, in adults, to narrow the nose.

In the past the surgical technic consisted in the complete excision of the abnormal mass. The resultant raw surface was then either permitted to granulate or covered with a skin graft. In the main these technics proved inadequate or wholly unsatisfactory for the manifest reason that a surgical wound permitted to granulate not infrequently leaves a permanent scar. Moreover, after the use of a skin graft there is a patchlike appearance.

The surgical operation for rhinophyma is contraindicated in the presence of subacute or acute inflammation of the nasal mucosa, or concurrent constitutional or local intranasal disease.

I have devised a technic which obviates the aforementioned inadequacy. The condition invariably, owing to hypertrophy, elongates the lower part of the nose and it is therefore merely necessary to shorten the nose to normal proportions, when the mass in its entirey can be removed. Sufficient skin remains in the upper part of the nose to be stretched (without undue tension) over the entire raw surface.

Correction of rhinophyma with the involvement of the alar rim is shown in figures 1 and 2. The patient's face and the intranasal areas are carefully prepared with green soap, metaphen and alcohol, used successively. To avoid intranasal influx of blood, gauze strips are introduced to plug only the posterior two-thirds of the nasal air-ways. The soft tissues of the nose are anesthetized locally.

Correction of rhinophyma without involvement of alar rim is shown in figures 3 and 4.

FIG 1 (A) Rhinophyma, with involvement of alar rim (B) corrected

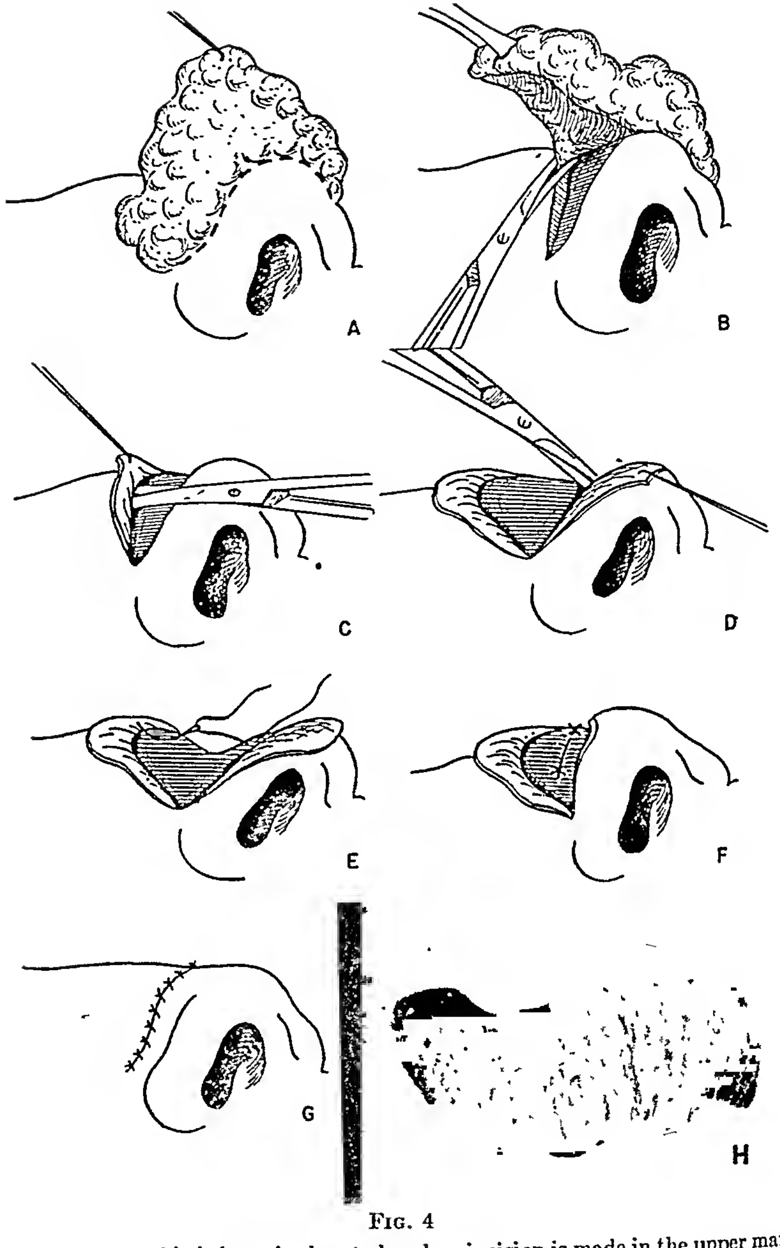

Fig. 4

(A) The hypertrophied tissue is elevated and an incision is made in the upper margin of the alae and nasal tip.

(B) The mass is completely excised at its extreme limits from the dorsum and lateral aspects of the nose.

(C) The normal skin over the dorsum and the underlying tissues are circumspectly freed with scissors.

(D) The skin over the nasal tip is then undermined from the lower lateral cartilages.

(E) and (F) A wedge of fibrosed tissue is excised from the dorsum of the lower third of the nose and several catgut sutures are used to draw the tip of the nose upward.

(G) The margins of the skin are then sutured into their new position with interrupted strands of black silk.

(H) Section of rhinophyma excised.

OBTAINING EXTREMELY LARGE SKIN GRAFTS

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In skin grafting of large areas, either for coverage of burns or for replacement of cicatricial contractures of neck, axilla, face, and dorsum of hand, the Plastic Surgeon has always been limited in the size of needed one-piece skin graft by the available dermatomes.

The Padgett Dermatome principle, in which the knife blade ascribes a parallel to a given cylindrical surface, has revolutionized the technique of taking skin grafts. Frequently its size 4 x 8 inches (10 x 20 cm.) proves inadequate to the demand for a larger one-piece skin graft, where the operator is attempting to eliminate suture lines over joints, over bony prominences, or along planes of skin tension. The 4 x 8 inch size has proven too tedious for extensive burn cases requiring several hundred square inches of skin.

A method of obtaining a larger (16 to 24 inches long) one-piece skin graft is here presented, using the regular Padgett-Hood Dermatome, yielding an increase of 360% or more.

TECHNIQUE OF TAKING EXTREMELY LARGE SKIN GRAFTS

This does not differ basically from that of the regular Padgett Dermatome technique.

Rotation of the drum counterclockwise, raising the leading edge of the drum with the adherent skin slightly above the contour of the donor site, and forcing the skin to follow in the direction of the leading edge, has been the method of choice, paying particular attention to the left and right margins of the drum as a guide in cutting the graft from the donor area.

After the skin graft has been cut, but while it is still attached to the body at the trailing edge of the drum, the knife is brought back to rest over the wrist and the skin is peeled off the dermatome (Fig. 1). The drum and the skin beyond the hinged skin graft are prepared, the glue is applied, and the drum re-applied so that now the leading edge of the drum is placed on the cut skin graft a few mm. from the hinge just where the training edge ends. While the knife is resting over the wrist, the assistant places the cut skin graft in the hollow of the drum. The knife is brought over the cut skin graft and the cutting is continued, resulting in one piece of skin graft consisting of two or more drum lengths depending on the number of re-applications of the drum and the extent of the donor site (Fig. 2.). The donor site for such extensive grafts is limited. The back, however, offers the best site (Fig. 3). In debilitated patients where there are irregularities in contour (sunken inter-costal spaces and prominent spinous processes

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THROW-AWAY BLADES FOR THE DERMATOME*

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Up until a short time ago the only blades available for the Padgett Dermatome were blades that came with the machine and required sharpening after each use. This was unhandy, as most surgeons were unable to get the blade sharp enough to be really satisfactory. In 1947, Sloan (1) introduced a holder which would hold either four Schick blades or double edge razor blades that had been broken to fit the adapter. This arrangement, however, was still a little unhandy and has not been universally adopted.

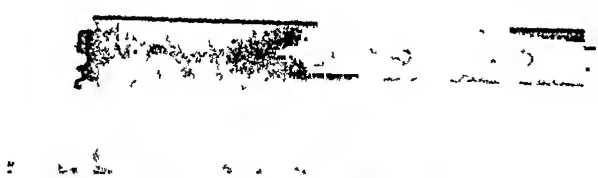

FIG 1. BLADE IN ADAPTER

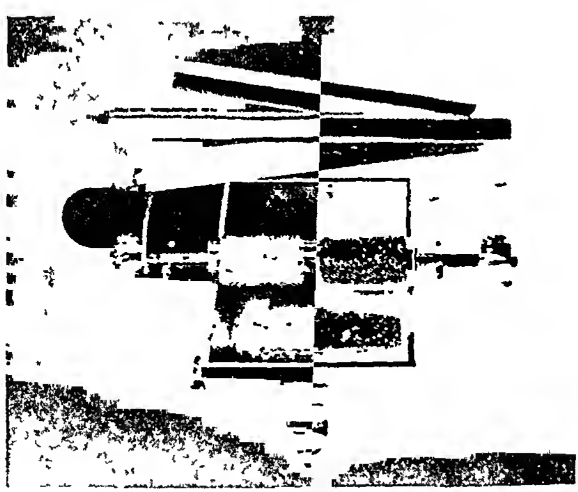

FIG. 2 BLADE PARTIALLY INSERTED SHOWING RELATIONSHIP TO CROSS BAR OF DERMATOME

A new holder is introduced which uses a six inch throw-away blade. The blade is cheap and can be disposed of after each case. No new holders or clamps are required to use this with the dermatome. The blade is simply set on the adapter

* Mfg. by Johnson Manufacturing Company, Chippewa Falls, Wisconsin.

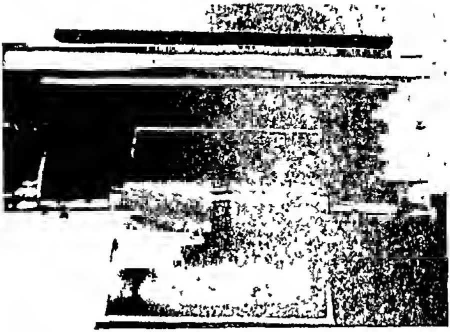

FIG. 3. BLADE READY TO USE

and placed in the position the regular blade occupies, with the throw-away blade lying next to the cross bar. A Little vaseline should be applied along the adapter before the blade is put on. This acts as and adhesive and the blade will cling to the adapter while it is being attached to the machine.

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A SUCTION ELEVATOR IN THE SURGERY OF CLEFT PALATE*

HÉCTOR MARINO, M.D.

Buenos Aires

The nutrition of the mucoperiosteal flap of a cleft palate is given by the palatine arteries, which can be easily severed during the operation, if the dissection is not carried out with the utmost care. The old procedures of Langenbeck, Dieffenbach, Warren, etc., do not give much significance to the preservation of those arteries, but modern authors as Veau, J. B. Brown, Blair, Lühmann, Vaughan, etc., describe technics in which the integrity of the vessels is basically important. Even when the ligature and section of the palatinae is sought, as in the procedures of Axhausen and Dorrance, the performance of the same requires a clear vision of the vessels. It is a common experience to find that during the operation the difficulties increase as the surgeon proceeds to the deeper parts of the palate, where the collection of blood impairs the vision of the most important structures. To expose these one recurs to the intermittent aspiration of

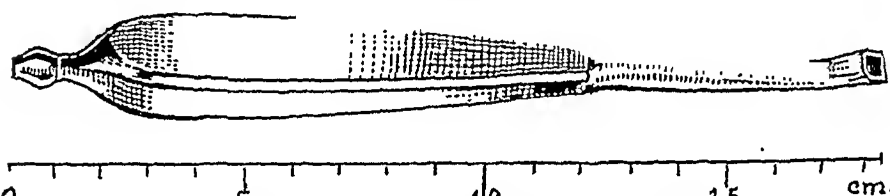

FIG. 1. THE SHAPE OF THE SUCTION ELEVATOR

saliva and blood with a sucker used by an assistant. But the field, in the angle between the flap and the processus palatinus, does not give much room for both the elevator and the aspirating tube; the result is that quite often the surgeon is operating without seeing the tip of his instrument.

The solution of this problem was found watching an appendectomy for gangrenous appendix performed by R. Finochietto. The dissection of the organ was made with the tip of a suction tube, which at the same time caught the blood and any septic materials that could fall into the peritoneal cavity. We saw at once the possibility of uniting in one instrument the periosteal elevator and the sucker, creating thus a hollow elevator, with a perforation that sucks all the fluids, leaving always the sharp edge well exposed. Figure 1 shows the shape, length and details of the tip, with the hole and the slight curve, which facilitates the insertion between periosteum and bone. We have employed this instrument since 1942 with satisfactory results. The field remains bloodless as the aspiration is made exactly where mostly needed, in the place where the instrument works guided by the surgeon himself. The assistant remains free to retract the flap and com-

* The suction elevator is made by J. H. Battisti, Boulevard Ocampo 476, Cordoba, Argentina and by George P. Pilling & Son Co. 3451 Walnut St. Philadephia.

plete the aspiration of the pharynx if necessary The dissection of the vessels is made under precise control, almost with the only aid of the elevator, which "combs" smoothly the tissues (fig 2)

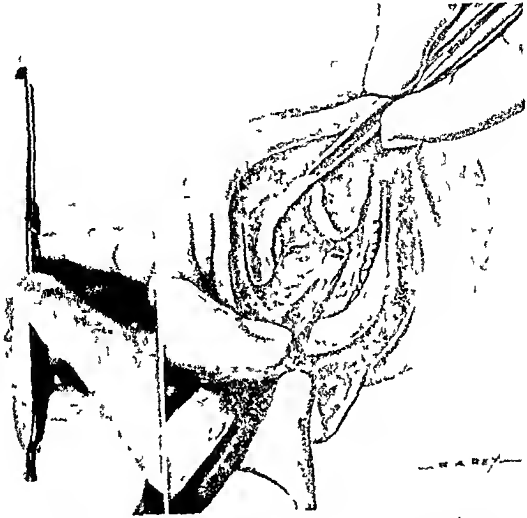

FIG 2 THE SUCTION ELEVATOR WORKING ABOUT THE PALATINE ARTERY

As for further uses of the suction elevator we feel that there are a number of situations where it can be employed As for instance it has found a place in the dissection of osteoperiosteal flaps in craniectomies, in operations on facial bones, etc Vaccarezza is already using a much larger model as only instrument to free the first rib in the thoracoplasty

SUMMARY

A new instrument which associates a periosteal elevator and a sucker is proposed for the surgery of cleft palate It is believed to be a useful adjunct to similar instruments as it insures a bloodless field under the cutting edge and therefore a perfect vision of the deeper structures of the palate

IMPROVEMENTS AND MODIFICATIONS OF PADGETT'S DERMATOME

HÉCTOR MARINO, M.D.

Buenos Aires

Since we started to use Padgett's Dermatome we found out that the perfection of its functioning depended—as one could expect—on the sharpness of the cutting blade. But we also found out that it was rather difficult to get a straight edge of razor-like quality. As everybody knows, any deviation of this edge is the cause of dents on the back of the graft and of difficulties during the cutting of the same. Trying to make the instrument more practical for non-specialized surgeons who very often do not have spare blades to change the dull ones, we had

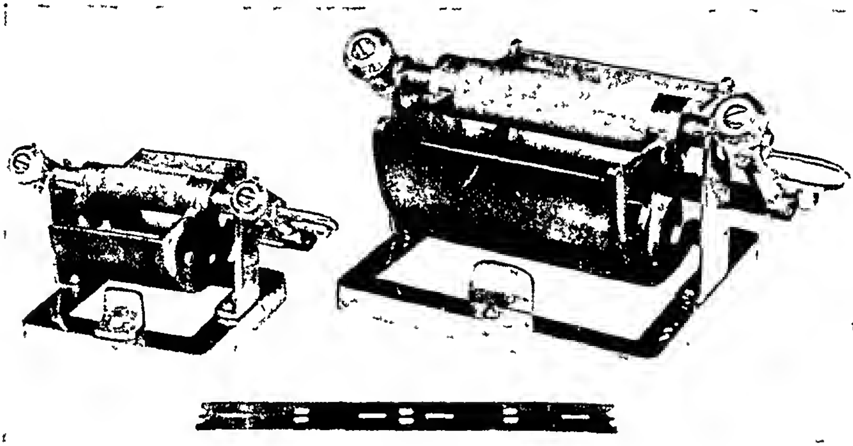

FIG. 1

the dermatome blade substituted by four "Valet" shaving blades. This improvement was suggested by the grating knife described by Poth in 1939 and was proposed again in 1944 by Shumaker.

However the small blades had some drawbacks as there were slight differences of distance and thickness due to lack of uniformity of manufacture. Therefore we had a better blade but we were far from perfection. In that time (13th, July 1943) we received a letter from Padgett which we quote textually: "We have never been able to get a satisfactory blade. The reason for this is that just about the time we started getting the Dermatome into production the war came on and because of the high priorities required on steel the various steel companies did not want to fool with extra nick nacks.

"We are going to try to get a thin blade made, one similar to the one you speak of, but to be made all in one piece. The expense would be so negligible the blades could be thrown away after they become dull".

As it can be understood we began at once to materialize the idea of Padgett and we were fortunate enough to have them made by an Argentine factory which named them "Injerta" They are made of Swedish steel, which gives a double edge of excellent sharpness, allowing to cut four or five drums with each side The design allows the use of the same blade holders which employed the shaving blades, but the results are far more satisfactory because no other blade can give the precision required by the mechanical principles of the Dermatome Besides the small cost of the blade allows it to be thrown away whenever it becomes dull without bothering to sharpen it again The throw-away blade suggested by Padgett has become a standard improvement of all the Dermatomes used in this part of the continent and we hope that this idea of its creator will be soon adopted by the plastic surgeons of the United States of America

Whenever one tries to obtain a graft from a curved surface of short radius or from the body of small children, the dimensions of the standard Dermatome can be of some disadvantage In all these circumstances the size of the drum and the displacement of the blade-holder are out of proportion to the size of the graft and the procedure can very easily fail or neighbouring parts injured To obviate these troubles we had a half size Dermatome made, which adapts itself very well to cut skin grafts in many places and situations where the use of the standard Dermatome would be out of question The experience taught us that, besides to its use in difficult places, it finds a good application in the general practice where small grafts are a common eventuality

The small Dermatome has a drum surface of ¼ of the standard drum Therefore tho blade can be obtained with two "Valet" blades of halving an "Injerta" blade with a strong forceps The small size of the instrument requires an exacting manufacture, but the results obtained make it a useful adjunct to the instruments of any plastic surgeon

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November 1948

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

SHOCK AND BURNS

Stewart, John D., Kennedy, Paul A., and Hale, Harry W., Jr.: A Study of Systolic Blood Pressure and Pulse rate in Traumatic Shock. *Surg. Gynec. Obst., 85:* 453, Oct., 1947.

Stewart and his associates point out the possible error of diagnosing the presence or absence of shock in severe trauma upon the systolic blood pressure and pulse rate. It is apparent that the essential disturbances of the condition such as reduction in cardiac output, reduction in peripheral blood flow and tissue anoxia are not always accompanied by the same signs. The transitory and labile nature of shock further demands that the clinical diagnosis be made on the sum total of physical signs.

To illustrate their contention, the authors present data on 204 seriously wounded soldiers who were considered non-transportable. Thirty-one, or 15 per cent, died in hospitals in the forward area. Blood pressures and pulse rates were established at the time of admission, after restorative intravenous therapy and postoperatively. The incidence of variation demonstrated that neither systolic blood pressure nor pulse rate was always reliable. There is, however, sufficient evidence to show their value in the majority of cases.

When restorative therapy was given, the blood pressure tended to rise to normal, while the pulse rate often rose away from normal. Thus, there was little correlation between these two factors before or after restorative measures and surgery. Systolic blood pressure appears to be the better prog-

nostic sign, but the authors urge caution in judging these two factors in shock

Fine, Jacob, Seligman, Arnold M, and Frank, Howard A: On the Specific Role of the Liver in Hemorrhagic Shock; Report of Progress to Date *Ann Surg*, *126* 1002, Dec, 1947

Regardless of its etiology, as pointed out by Fine and his associates, the principal disturbances in traumatic shock are the decrease in rate of blood flow and pooling of the blood in the capillary beds with resultant anoxia When this state extends beyond a certain degree, shock becomes "irreversible," and therapeutic measures are only temporary interruptions in the progressive tread toward death

Four systems of tissues are considered essential to life even for brief intervals, namely the central nervous system, the heart, the lungs, and the liver All other tissues or organs may fail completely without death Thus a consideration of these vital organs may aid in solving the problem of irreversible shock

Quoting the work of Chambers, Wang, and Phemister, the authors point out that there is little evidence to incriminate the central nervous system in the development of the irreversible phase of shock Similarly, no primary disorder in the central circulation has been detected to explain the progressive decompensation, and respiratory disturbances are generally due to reflex metabolic and humoral factors

Thus, the extensive biochemical disturbance in shock must be a failure in generalized cellular function or else a disorder of one of the essential organs There is reason to believe that a biochemical lesion of the liver is responsible for the progressive shock state Evidence is available to demonstrate that liver tissue respiration and resistance to shock are superior in the presence of a prefed high protein diet If the liver is primarily injured, it is poorly resistant to shock Moreover, in shock the rate of blood flow and the degree of oxygen saturation are reduced in the liver, thus adding to chemical changes in the liver if these alterations exist In traumatic shock, the secretion of bile is reduced or stopped, fibrogen is reduced, deamination is deficient, and a damaged liver more rapidly leads to shock development and extremes of this state

Fine, Seligman and Frank found that the above hypothesis is supported by experimental evidence The liver of a dog in hemorrhagic shock perfused by cross circulation with a healthy animal prevented the development of irreversible shock, while cross circulation excluding the liver of the "shocked" animal did not alter the irreversibility of the state of shock Thus it appears that protection of the liver with arterial blood results in recovery from irreversible shock and indicates that the liver is directly responsible for peripheral circulatory failure This indicates two major problems, the mechanism of the liver and the contribution of the donor animal As for the first, a liver toxin may be elaborated, or there may be a decrease in some liver humoral factor which normally helps to maintain vascular tone There is no evidence of the latter, while many investigators support "toxin" theories In view of the above mentioned liver perfusion studies, the lack of effect on the donor animal tends to minimize the importance of toxin

Regarding the contribution of the donor animal, it may be simply oxygen for the anoxic liver, or a more elaborate process such as an essential substance no longer elaborated by the dog in shock

If the liver of an animal in irreversible shock is auto perfused from its own femoral artery, an improvement is effected but recovery fails, which indicates that the donor animal provides more than oxygen alone Reservoir whole blood is likewise inadequate The problem remains to determine what service the donor animal contributes to the liver in recovery perfusions besides that of correcting the anoxia of the liver tissue

Keyser, J W. Metabolic Study of Burn Cases *Ann Surg*, *127* 605, Apr, 1948

In a metabolism study of a series of patients with burns, the following evaluations were determined by Keyser urinary nitrogen excretion, nitrogen balances, nitrogen in burn exudates, plasma proteins, creatinine and creatine excretions, proteinuria, chloride plasma levels and excretions, and blood sugar

levels. The methods employed in each set of evaluations are discussed as well as the results obtained. In general, urinary nitrogen loss did not seem excessive, for negative nitrogen balances appeared more likely to be caused by low intake of protein rather than by nitrogen loss. The initial nutritional state of the patient appears to be of utmost significance in determining the subsequent state of nitrogen balance. It was found that eggs and milk were most effective in correcting a negative nitrogen balance state. Measurements of nitrogen in exudate loss were 2 per cent to 25 per cent of the calculated total nitrogen output. Likewise, Keyser warns of misleading plasma protein determination due to therapeutic dilution of blood volume. Creatinuria was observed in three patients with relatively small burns, but the author feels that this may have been due to fever. The studies revealed a suppression of plasma chloride and urinary chloride excretion in the burned patients. It is suggested that saline be used with reconstituted plasma due to the lack of the electrolyte in these preparations. Blood sugar determinations did not appear to be of significance.

MALIGNANT GROWTHS

Pack, G. T., Ehrlich, H. E., and Gentil, F.: Radical Amputations of the Extremities in the Treatment of Cancer. *Surg. Gynec. Obst., 84:* 1105, June, 1947.

In 20 years more than 1500 cases of malignant tumors of the soft somatic tissues of the upper and lower extremities and trunk, including over 900 cases of melanoma were encountered on the Mixed Tumor Service of the Memorial Hospital, New York. From this experience Pack and his associates state that highly malignant connective tissue growth, melanomas, and metastasizing epitheliomas in selected cases must be dealt with radically at the onset if there is to be any hope for the patient's survival.

On the limbs with regional node involvement, wide local excision of the primary tumor subsequently followed by a regional node dissection has proved unsatisfactory. Only by "excision and dissection in continuity" can the primary lesion, intervening lymphatic pathways, and involved regional nodes be entirely removed. If this is not feasible, exarticulation of the limb combined with excision of the regional lymph nodes should be done.

Interscapulothoracic amputation is indicated in the case of malignant tumors of the upper limb which extend to, or through the capsule of the shoulder joint or in its vicinity; extensive infiltrating cancers involving the deltoid, subscapular and pectoral muscles, particularly the unencapsulated myosarcomas, neurogenic sarcomas, liposarcomas, synoviomas, fibrosarcomas and spindle-cell sarcomas of undetermined histogenesis, *et cetera.* In the treatment of melanoma of the skin of the upper limb with demonstrable involvement of the axillary lymph nodes (proved by aspiration biopsy) and in anatomically similar tumors, intrascapulothoracic amputation is indicated whenever excision in continuity cannot be carried out. This type of amputation occasionally has a place in palliative therapy.

According to the authors, the same principles apply to similar tumors of the lower extremity. Hip joint disarticulation with and without deep iliac dissection is discussed. The technic of the several amputations of the extremities, including sacroiliac disarticulation (hemipelvectomy) is outlined together with the indications for each.

Sixty-five patients were subjected to one of the major amputations, with no operative deaths. The 5-year survival rate following interscapulothoracic amputation was 45 per cent, and for hip joint disarticulation, 33.3 per cent. The net survival rate in cases of sacroiliac disarticulation was 71.4 per cent.

Eberhard, Theodore P.: Treatment of Epitheliomas of the Skin. *Radiology, 49:* 620, Dec., 1947.

The histology of a lesion, as viewed by Eberhard, is no criterion for the choice of treatment. Rather should one base his selection upon the size and location of the growth, using that method which can be most effectively employed, which will give the best cosmetic result, and impose the least hardship upon the patient. Since this holds good for almost no malignant skin tumors except the epitheliomas, biopsy is advised. If the lesion is less than 3 mm. in diameter, an adequate biopsy will remove practically all of the tumor. If the location of the lesion presents no contraindication to wider exci-

sion immediate removal should be done. If pathological examination shows that the lesion extends to the limits of the section, re-excision or irradiation must be carried out.

If important, radiosensitive contiguous structures cannot be protected, radiation is contraindicated. A narrow scar is preferred by Eberhard to a round blanched area, but radiation, properly done, can usually produce results superior to those achieved by skin grafting of any type. When the tumor lies upon the bulbar conjunctiva or deep in the conjunctival fold, it is impossible to shield the globe and retrobulbar fat. Very small lesions in these locations can be excised without damaging the eye. On the contrary, even tiny excisions along the lid margins produce defects. With the proper use of subpalpebral lead shields, growths of considerable size may be safely irradiated without damage to the eye and with little or no ultimate defect in the contour or function of the lid. At the canthi surgery will almost inevitably destroy either the lacrimal gland or duct, both of which can usually be preserved by the use of radiation.

Metastases should be treated by radical block dissection whenever possible. In most instances as advised by the author, therapy of the node should be entirely separate from that of the primary lesion and should be deferred.

Surgery in the present series was done exclusively with a cold knife. Cautery destroys the specimen and also makes it impossible for the operator to know the depth to which he has gone. The round white scars are as bad as the worst radiation scars. The "electric knife" chars the tissues slightly, distorts the cell structure of the specimen, and again leaves unnecessarily prominent scarring. The supposed cancericidal action of the heat does nothing but give the operator a false and misleading sense of security.

Seven hundred and sixty lesions in 192 patients were treated in 3 years. The results of the three methods of treatment, roentgen ray, radium and surgery, are compared by using the recurrence rate as a basis and no statistically significant differences are observed.

Taylor, G. W.: Evaluation of Regional Lymph Node Dissection in the Treatment of Carcinoma. *New England J. Med.*, 226: 567, Mar. 5, 1942.

Taylor bases evaluation of lymph node dissection on a review of over 5000 cases from the Massachusetts General Hospital, Pondville Hospital and Huntington Memorial Hospital. Dissection is indicated when operable metastases are present. Enlargement of lymph nodes to a size greater than 1 cm. is strong evidence of metastasis but may still be due to inflammations. The tendency to form metastases is associated with long duration, large size, high grades of malignancy, an invasive as opposed to a papillary type of growth and recurrences at the site of the primary cancer.

Optimum Time for Dissection: Dissection may be reasonably deferred until metastasis can be detected. On the other hand when there is considerable likelihood of metastasis in a patient in good general condition who may find it difficult to report regularly, prophylactic dissection is preferred. The author further holds that mortality and complications following dissection are minimized if the dissection is postponed until after healing of the site of the primary carcinoma. The optimum time for prophylactic dissection is two to four weeks after eradication of the primary carcinoma. If the lymph nodes are involved when the patient is first seen, the interval may be shortened but the dissection should still be deferred until after treatment of the primary carcinoma.

Extent of Dissection: Carcinomas of the lip and buccal mucosa rarely form metastases below the level of the omohyoid muscle, and dissections in these cases may therefore be limited to the upper neck. Bilateral dissections are frequently indicated in lesions involving the lip and the external genitalia. Bilateral or multiple dissections should be performed in stages rather than simultaneously.

Concerning preoperative or postoperative radiation, Taylor is of the opinion that preoperative treatment postpones the dissection, and that postoperative treatment is of no benefit after a proper block dissection.

HAND AND WRIST

Tuckey, Clarence A., and Moon, Henry D.: Hard Dorsal Post-Traumatic Edema of

the Hand. *Plast. & Reconstruct. Surg.*, *2:* 563, Nov., 1947.

Hard dorsal post-traumatic edema of the hand is a relatively rare condition. The swelling is hard and does not pit. It does not extend to the fingers or wrist. Two cases of hard dorsal post-traumatic edema of the hand treated by excision of the mass are reported by Tuckey and Moon. The microscopic picture of the lesion in one case showed dense fibrous connective tissue arranged in bundles, moderate vascularity with some endothelial proliferation and perivascular lymphocyte collections. Among the connective tissue bundles there were macrophages containing hemosiderin. Occasional small islands of fat were present. Bursae present were lined with a layer of flat endothelial cells. The authors considered that the fibrous tissue formation might be secondary to hematoma formation. Complete excision of the fibrous tissue is considered the treatment of choice.

Quigley, Thomas B., and Urist, Marshall R.: Interphalangeal Joints—A Method of Digital Skeletal Traction Which Permits Active Motion. *Am. J. Surg.*, *73:* 175, Feb., 1947.

The maintenance of active motion is necessary in the treatment of metacarpal and phalangeal fractures if good function is to be preserved. Various means of traction are often used to maintain reduction. Common sites for traction in the fingers are: (1) the finger-nail, (2) the pulp of the distal phalanx, (3) the distal phalanx, (4) the middle phalanx, and (5) the proximal phalanx.

Quigley and Urist have used an area on the dorsal surface of the middle phalanx where only skin and fascia overlie the bone for skeletal traction. The cortex is drilled at an angle of 45 degrees distally with a No. 6 dental burr through a stab wound. A hook is engaged in this hole and steadied by a small dressing. Rubber band traction attaches this hook to a banjo splint fixed with plaster, with traction so arranged as to place the fingers in flexion. Active motion over a limited range is started at once. Traction is rarely maintained for more than 3 weeks. The method is suited to fractures of proximal phalanges and unsupported metacarpals. Seventy patients have been treated by this method. The use of the method is described in three case reports.

Mahoney, James H., Phalen, George S., and Frackelton, William H.: Amputation of the Index Ray. *Surgery*, *21:* 911, June, 1947.

As the index finger is next to the thumb in importance, Mahoney and his colleagues advise that it should be salvaged whenever possible. However, salvage of the finger in some cases results in a loss of efficiency of the hand. This is particularly true if the index finger was amputated proximal to the proximal interphalangeal joint. In such cases, removal of the remaining finger and the second metacarpal bone results in improvement in function of the hand. The procedure is also advised when the index finger is so badly damaged that surgery holds little promise of restoring function to the digit. The procedure also improves the cosmetic appearance of the hand.

Operative Procedure: An incision is made about the base of the index finger, extending longitudinally on the dorsum of the hand to the base of the metacarpal. The metacarpal is exposed and divided just distal to its base. The base remains to preserve the insertion of the extensor carpi radialis longus. If possible, the tendon of the first dorsal interosseous muscle is isolated and inserted into the tendon of the second dorsal interosseous. The digital nerves are isolated, ligated and buried. Through a transverse incision at the wrist, the flexor tendons of the index finger may be withdrawn and transferred to the flexor tendons of the long finger.

Stevenson, Thomas W.: Synovitis of the Wrist. *Plast. & Reconstruct. Surg.*, *2:* 443, Sept., 1947.

Synovitis of the wrist is discussed by Stevenson.

The function of synovia is the reduction of friction at points where power is transmitted around a corner. Some parts of tendons lie in a canal lined by a parietal layer of synovia, with the tendons surrounded by a visceral layer. Fluid forms as a result of irritation.

Flexor tendons are surrounded by synovia beneath the transverse carpal ligament. The tendons of the thumb and fifth finger are covered to their insertions, while the three

middle fingers are sheathed to the mid palm The flexor carpi radialis has a sheath where it runs through the transverse carpal ligament and the groove of the greater multangulum

On the dorsum of the wrist, as pointed out by the author, there are sheaths beneath the dorsal carpal ligament but none extend to the finger The abductor pollicis longus and the extensor brevis are in a sheath, and the extensor carpi radialis, longus and brevis, in another Over this is the sheath of the extensor pollicis longus A large central sheath covers the extensor digitorum communis The extensor digitis quinti and the flexor carpi ulnaris have individual sheaths

When pathologically distended, the sheaths appear to extend well above and below the transverse ligaments Synovial effusion denotes irritation which may be mechanical in nature Pain and effusion tend to diminish wear, and rest permits repair Crepitus and grating sensation may be present in cases of synovitis Less acute cases or repeated trauma may result in more permanent changes These include persistent effusion, thickening, congestion and corrugation of synovia Synovial surfaces may become covered with villi In some cases fibrosis causes restriction in tendon motion Sometimes tendon fibres become separated, pale and edematous

MISCELLANIES

Test, Avery, and Falls, Harold Dominant Inheritance of Cleft Lip and Palate in Five Generations *J Oral Surg*, *5* 292, Oct, 1947

Test and Falls became interested in analyzing a family pedigree because of the occurrence of accessory salivary glands in the lower lip of several of the members

Straith and Patton have described the association of this condition with cleft lip and palate In this family all the minor manifestations of this deformity were searched out to determine the inheritance pattern This gene exhibited dominant inheritance of an irregular type There was no evidence of sex linkage, sex limitations, or sex influence In this family of five generations, there were many variously affected Four males and five females had cleft palate, two males and three females had cleft lip, three males and five females had accessory salivary glands, and two females had cleft uvula

These anomalies show that, singly or in combination, in mild or severe form, the affected persons are capable of transmitting the trait to any degree of the deformity in approximately half of his or her offspring

The variable expression of a gene is rather common in human heredity, but is especially prevalent in this syndrome

The sociological aspects of these deformities as they affected this particular family pedigree, are discussed

Crawford, G Marshall· Injection Therapy for Angiomas *J A M A*, *137* 519, June 5, 1948

A report on a group of 233 patients with 310 vascular tumors is made by Crawford These patients presented a series of 190 hemangiomas, which were treated by the injection of sclerosing agents Good results were obtained in 64 per cent of the entire group, and an additional 26 per cent had fairly good effects Only the remaining 10 per cent of the lesions came out poorly or were failures

The lesions of the youngest patients and those of shortest duration responded more satisfactorily Lesions located about the face and in the mouth gave the poorest results The method of approach in the therapy of any given lesion should be selected in accordance with the individual circumstances, and other measures may seem more advisable than sclerosing injections This form of treatment more nearly approaches a means of assistance to the natural processes which tend to bring about spontaneous sclerosis in hemangiomas

Excision results in the quickest cure for selective lesions, and the results are usually satisfactory Large angiomas seldom lend themselves to suitable surgical approach, and many small ones are so situated as to make excision unattractive

Radiation is effective to a large degree when properly used but carries some hazards and has distinct limitations Roentgen rays and radium are not generally advised after the age of two years Either form of radiation should be avoided on the scalp, around the eyes, lips, genitalia, breasts and digits, bony prominences or epiphyses They are

not generally advisable for extensive lesions anywhere.

In Crawford's group of patients the average number of treatments per lesion for all angiomas, regardless of result, was 8.24 injections. This therapy required an average time of 8.34 months. The greatest number of injections given for any one lesion was 39. The maximum amount of sclerosing solution injected into any patient at one treatment was 10 c.c. Lymphangiomas have not responded well to sclerosing injections. Six patients with granuloma pyogenicum did exceedingly well. Four patients were promptly relieved of their lesion after one injection.

The greatest number of patients in this series were injected by invert sugar and sodium chloride—30 per cent invert sugar, 10 per cent sodium chloride and one per cent phenylethyl alcohol. This was found to be comparatively free from reaction, perhaps less painful and productive essentially of as good results as from sodium morrhuate or sodium citrate solution. The quantity of solution instilled at the first treatment varies from .05 to 0.5 c.c., in accordance with the size of the lesion. The increase in quantity of the solution can be rapid, with additional treatments if the lesion is large. The frequency of injections depends upon the relative activity of the individual tumor. If an angioma is steadily enlarging, it may require treatments every week or two until growth is arrested. Later an injection is given every one to three months. It is of primary importance to keep the solution from being deposited too superficially since this will nearly always eventuate in sloughing. If blanching is observed, that particular area has received sufficient fluid and the needle should be moved to another region of the tumor.

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